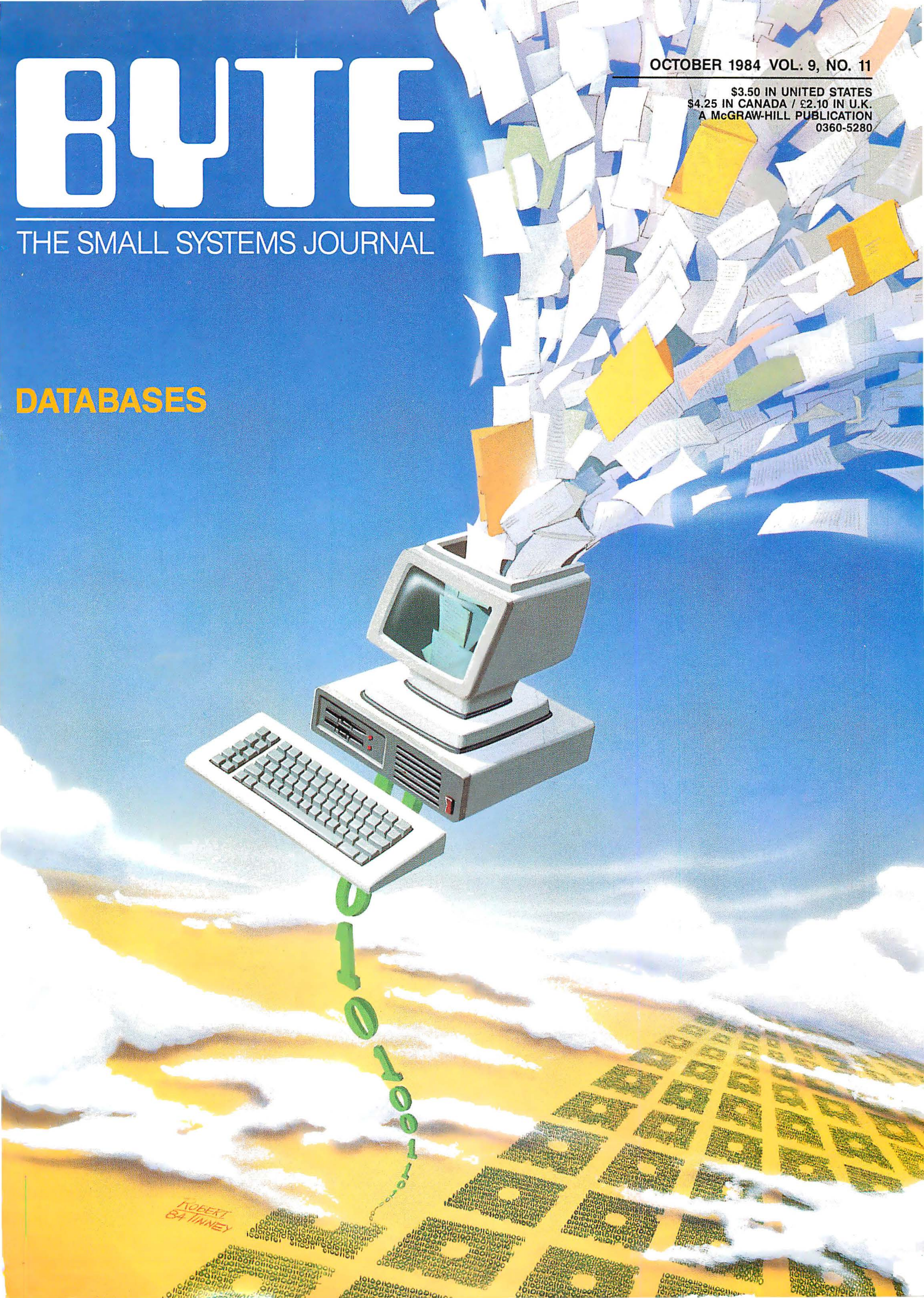


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DATABASES

Announcing a small imp

It's 12″ x 11½″ x 2¼″.
It weighs less than 8 pounds.*
And costs less than $1,300.**
Yet with 128K, the new Apple® IIc Personal Computer is a lot bigger than it looks.

The IIc has a full-size keyboard.



Because it's inherited all the talents of the eminently talented Apple IIe:

The versatility to run over 10,000 different software programs.

The ironclad reliability of the first true VLSI motherboard.

And the artistic ability of 16 high-resolution colors.

The IIc also has some talents of its very own.

For instance, a switchable 80/40-character display.

Switchable QWERTY/Dvorak keyboard.

Thin, isn't it? Even with its built-in disk drive.

A built-in half-high 143K single-sided disk drive.

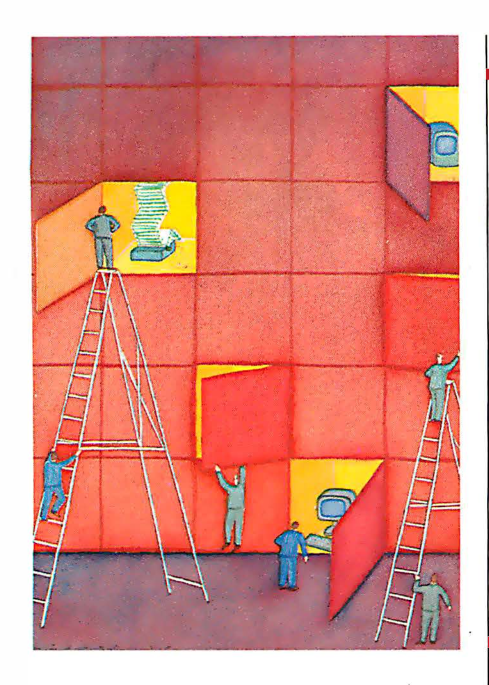
Built-in serial ports for modems, printers and an extra half-high drive.

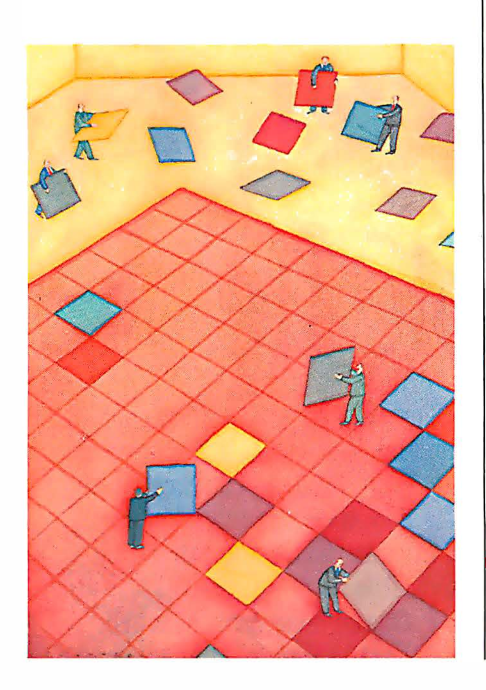
Even built-in mousetronics so it's ready to use a mouse and all the new Apple II mouseware.

And our newest brainchild is certainly not an orphan.

You can grow it with a whole family of Apple II accessories and peripherals.

C·O·N·T·E·N·T·S





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THEME: DATABASES

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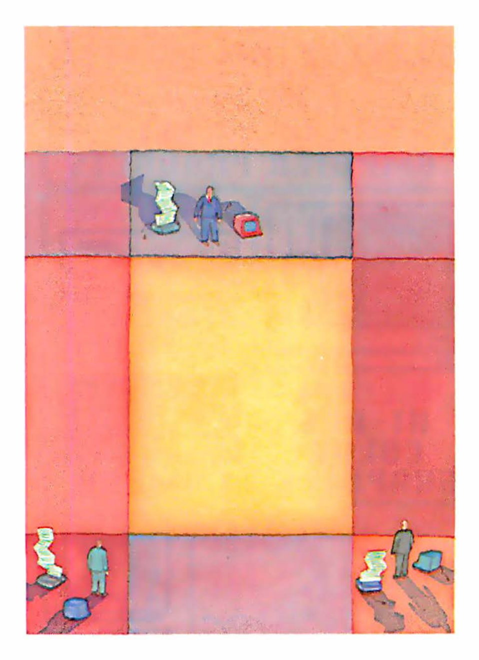
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October

VOLUME 9, NUMBER 11, 1984



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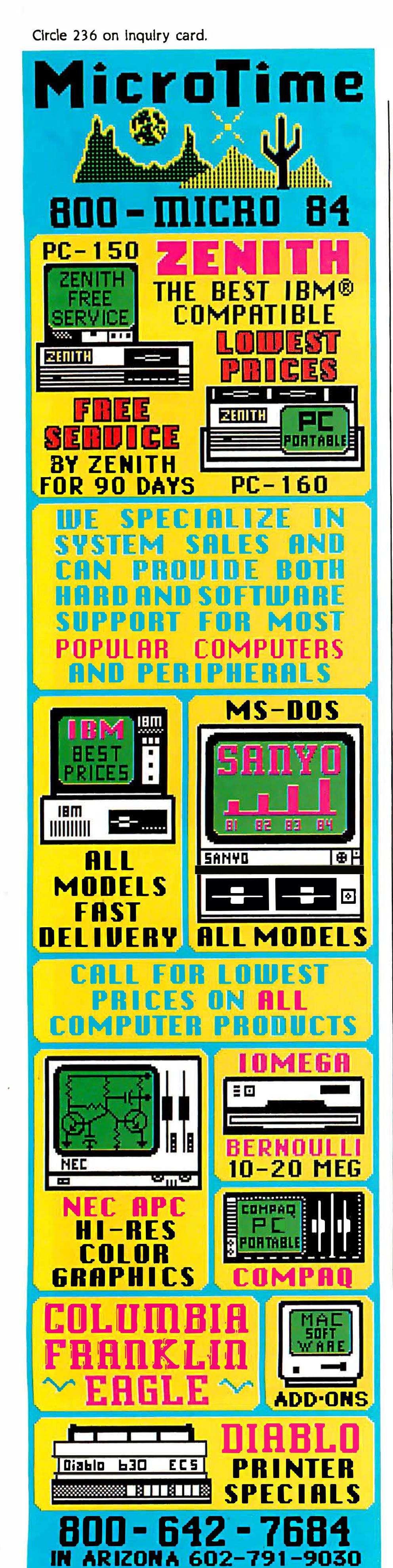
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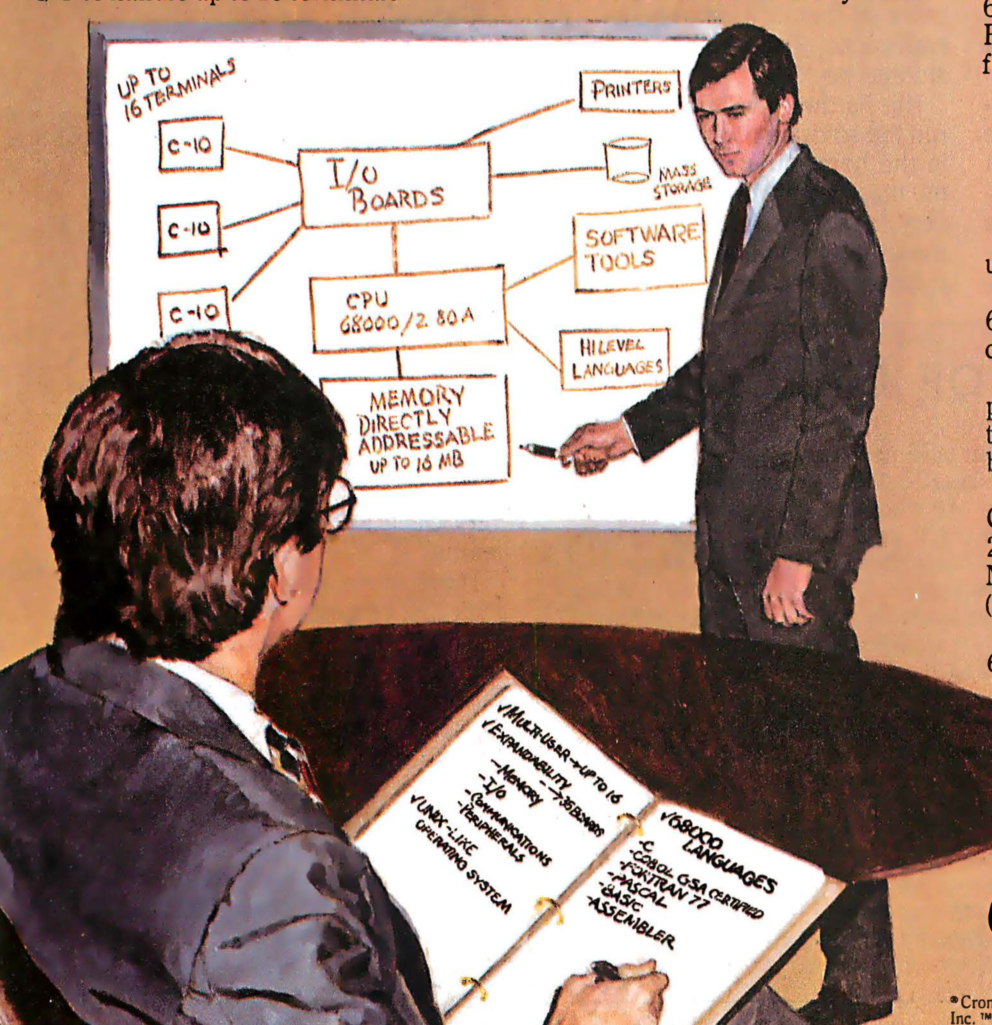
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THE CHALLENGE OF THE HOME COMPUTER

Almost all major makers of personal computers have concentrated on the business market and on its most obvious applications. From the moment when VisiCalc made the Apple II useful in business, computer makers and software houses changed their blue jeans and sandals for gray flannels and wingtips. There was nothing wrong about this. Business applications were the things that could be done easily for the dollars that were available and with the technology that was available.

Unfortunately, the rush to the business market somehow tainted the home computer. Some people forgot that the problem was with the technology available for the dollars the home could afford—not with the concept of the home computer. The educational and entertainment value of today's home computers makes them hot consumer items for many people but is not sufficient to make the home computer a universal appliance. Neither technology nor economics is yet ready for that.

Home computers must advance by a generation before they will be useful, friendly, and entertaining enough for everyone. At the prices of today's Commodore 64, home users will need the computing power of 32-bit processors, a megabyte or more of memory, and compact but high-capacity and high-speed mass-storage devices.

This hardware will be necessary to run the software required for success in the home. The software must be multitasking, highly integrated, and very friendly. It must do something useful and entertaining for every member of the family. It must eliminate much domestic drudgery: scheduling vacations, holidays, medical appointments, and social events; handling business and personal communications; managing finances and keeping records; helping with school work and with work brought home from the office; and providing access to important reference works. Perhaps most important, the home computer must be able to learn by observing, to acquire expertise in the family's interests and needs.

Curiously, the successful home computers of tomorrow may resemble today's revered AI research machines. These often have 3½ megabytes of RAM, 32-bit processors, very high resolution graphics, and large Winchester disks.

Similar developments in home computers may seem distant indeed. But Philips and Sony are both working on 800-megabyte optical-storage devices based on compact audio disks. Production 256K-bit RAMs will soon abound, and megabit chips are on the horizon. Several 32-bit microprocessors are here or soon will be. And some AI researchers say we are very, very close to creating software that learns.

These developments won't have their first commercial applications in the home, but they will one day make the home computer a universal appliance. Today's pause in the sales of personal computers gives manufacturers a chance to confront the challenge of developing successful home computers, opening a vast market, and enriching the lives of millions. Let's hope someone will be ready to meet the challenge as soon as technology and economics permit.

—Phil Lemmons, Editor in Chief

THE BIRTH OF BYTENET

In September, BYTE started a project in computer conferencing as a means of enhancing the content of the magazine. The 200 participants, to whom we are providing free connect time for the months of this experiment, include about 100 of our subscribers chosen by lot (many in a drawing at the BYTE Computer Show in San Francisco), several of our authors, and other people interested in personal computing. The first conferences will discuss Macintosh, the IBM AT, BYTE Reviews, Ciarcia's Circuit Cellar, Pournelle's Computing at Chaos Manor, and other topics. Steve Ciarcia and Jerry Pournelle will be among the participants, as will Bill Raike, our man in Tokyo, and Asao Ishizuka of Nikkei BYTE.

We believe that this project will lead to enhancements in the content of the magazine. It will keep us in closer touch with the interests of our readers and will help us learn the best ways to use electronic communications in conjunction with our traditional print publication. We'll let you know about new developments in this area as soon as we can.

As a service to all subscribers, we are making some listings from BYTE articles available on a bulletin board that we call Baby BYTEnet. The number is 603-924-9820. For the present, there is only one telephone line available, and users must bear their own long-distance charges.

For those not yet participating in BYTE electronic communications, please write us about your interests and needs in telecommunications.

Staff-written highlights of late developments in the microcomputer industry.

Data General Unveils 9-pound Portable Computer

Data General planned to introduce its Data General/One in late September. The computer includes a CMOS 8088 microprocessor, 128K bytes of CMOS RAM (expandable to 512K), a 640- by 256-pixel liquid-crystal display (7½ by 10¼ inches) with full-height characters, and two RS-232C serial ports, one of which is also RS-422A compatible. Functionally compatible with the IBM PC, the DG/One will be priced at less than $3000 with one 720K-byte 3½-inch floppy-disk drive and room for a second drive and for a 300-bps modem. An optional external 5¼-inch disk drive and a portable printer are also available.

IBM Announces PC AT, Network

The Personal Computer AT is an 80286-based computer using PC-DOS 3.0, a 1.2-megabyte floppy-disk drive, and an optional 20-megabyte hard disk. The base machine with one floppy-disk drive and 256K bytes of memory is priced at $3995; with 512K bytes and a hard disk, the price is $5795. The display adapter and monitor are not included. The AT is compatible with the IBM PC but can also use expansion cards using an extended 16-bit bus. IBM also announced Topview, a multitasking windowing environment that can run MS-DOS 1.0 or 2.0 programs, and the PC Network, a broadband local-area network for the IBM PC, PC XT, and AT. (See page 108 for more information.)

Commodore Will Not Advertise Vaporware, Buys Amiga

The Federal Trade Commission and Commodore Business Machines signed a consent agreement in August, under which Commodore agreed not to advertise capabilities that don't yet exist. Commodore had advertised CP/M capabilities for its Commodore 64 computer long before its optional Z80 coprocessor was available.

The FTC says it will investigate any companies that advertise capabilities or products that are not ready at the time the ad is run. (A company may advertise planned products if the ad mentions that the product is not yet available.) The FTC efforts will not apply to company announcements of product plans, unless paid ads are run.

Meanwhile, in England, Sinclair Research agreed not to make unrealistic claims about delivery dates for new products, following complaints under Great Britain's Fair Trading and Trade Descriptions Acts. Sinclair missed delivery schedules following introduction of each of its computers in England, including the recently announced QL.

Commodore has purchased Amiga Corp., which has developed a 68000-based microcomputer with a custom-graphics coprocessor. Amiga had planned to sell the machine for less than $1500. Shortly before the sale was announced, Atari sued Amiga, charging that the sale to Commodore violates agreements between Atari and Amiga through which Atari would have licensed the Amiga computer technology. Earlier, Amiga had sold its joystick line to Pride Electronics, which manufactures the joysticks.

IBM, DEC Announce Artificial-Intelligence Products

IBM displayed a number of products at the National Conference on Artificial Intelligence in August. It showed versions of the LISP and Prolog programming languages for the IBM 370; Scratchpad II, software that allows algebraic information to be entered directly on the screen instead of requiring a computer program; PRISM, an experimental expert system "shell"; and Handy, an IBM PC-based tool that can be used as an interface for AI applications.

Digital Equipment Corporation also displayed new third-party products at the conference. For the Rainbow 100 computer, DEC showed Gold Hill's GCLISP and Prologia's PROLOG II. DEC also showed products for its VAX and PDP-11 computers, including Inference Corporation's Automated Reasoning Tool, for developing expert systems; Interlisp, a LISP-based programming environment; PLUME, a tool for constructing natural-language database interfaces; and SRL+, an environment for developing expert systems.

(continued)

Tabor Adds 3½-inch Drive

Tabor Corporation, Westford, MA, is now making a 3½-inch floppy-disk drive in addition to the 3¼-inch drive that was its only product for the past year. Tabor and Dysan Corp. had sought to make the 3¼-inch soft-jacket disk the standard microfloppy, but major computer makers—including Apple and Hewlett-Packard—chose the 3½-inch hard-jacket disk and drive instead.

Tabor says it will continue to support the 3¼-inch drive and that several manufacturers are shipping computers using the drives. However, only one company sells a microcomputer using the 3¼-inch drive. Seequa began shipping the Seequa 325, similar to its IBM-compatible Chameleon portable computer, in August, but a spokesman said that the 3¼-inch disk version would be manufactured in quantity only if demand is present. "We're not betting the farm on it," he said.

Two other companies had announced machines using the 3¼-inch drives. Educational Microcomputer Systems says its product is on hold while it is converted to use 3½-inch disk drives instead. General Scientific Corporation says it is shipping workstations with 3¼-inch drives but in limited quantity because of the small market for its PDP-11/23-based product.

Micro Peripherals Inc. had begun manufacturing 3¼-inch drives under a license from Tabor, but it has since discontinued them due to a lack of interest. Seagate also licensed the 3¼-inch drive but has not produced any. Dysan, which makes 3¼-, 5¼-, and 8-inch floppy disks, said it would publish popular MS-DOS software titles on 3¼-inch disks this spring. Instead, Dysan began selling the software in August for the Seequa 325 only.

NANOBYTES

Microsoft will unveil version 2.0 of its BASIC for the Macintosh. The new version will be priced well under $200, with upgrades available to those who bought the earlier BASIC. Among the changes are sound and music capabilities, multiple output windows, pull-down menu design, structured programming features, optional use of line numbers, and access to Quickdraw graphics routines from BASIC. . . . **Verbex** plans to unveil a continuous speech-recognition workstation this month. The Model 6000 will have a vocabulary of 100–120 words and a price less than $5000. . . . **American Optical** is selling special Videoterminal Glasses for people who use computers. The tinted safety glasses are priced at about $100 and are also available in prescriptions. . . . **ENG Manufacturing Inc.**, Chandler, AZ, has announced Chirpee, a $180 "voice command module." The speech-recognition unit works with Commodore computers, with versions planned for the Apple II and IBM PC. Chirpee does not work with off-the-shelf software. . . . **DFE Electronic Data Systems**, Stutensee, West Germany, has announced the Tiger-32, a coprocessor board for the IBM PC. Included for $2495 are National Semiconductor's 16-/32-bit 32016 processor, 512K bytes of RAM, and the XENIX operating system. . . . **Tandy** now sells a $400 direct-connect 300/1200-bps modem. . . . **VisiCorp** has sold its Visi On integrated-software technology to **Control Data Corporation**. . . . **Intel** is now shipping 512K-byte EPROMs. . . . **IBM's** new keyboard for the PCjr may have had the desired effect: by late August, many dealers reported strong sales even though the replacement keyboards weren't sent to dealers until mid-September. . . . **Corona Data Systems** unveiled a laser printer using the same Canon printer mechanism found in Hewlett-Packard's LaserJet and other laser printers. The Corona Laser Printer will have a list price of $3395. . . . **The International Standard Book Numbering Agency** announced that microcomputer software should be included in the ISBN system used by book publishers. More than 10,000 software titles from 1500 companies had been assigned numbers by August. . . . **Newstar Software**, Pleasant Hill, CA, has introduced a Japanese version of its NewWord word processor that supports English, kanji, and katakana characters. . . . **Osborne Computer Corp.**, now reorganized and expected to emerge from Chapter 11 protection, is selling the same IBM-compatible, battery-powered portable computer overseas that **Morrow** is selling in the U.S. Morrow calls the machine the Pivot; Osborne will sell it in England as the Encore and elsewhere as the Osborne 3. The computer was developed by Vadem, a start-up company funded by Morrow.

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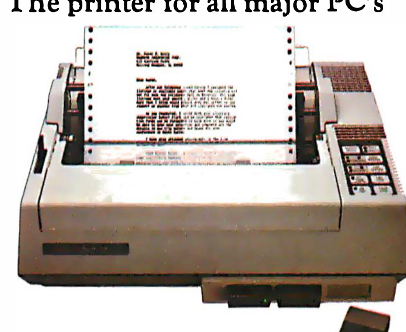
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The TI 855 Printer

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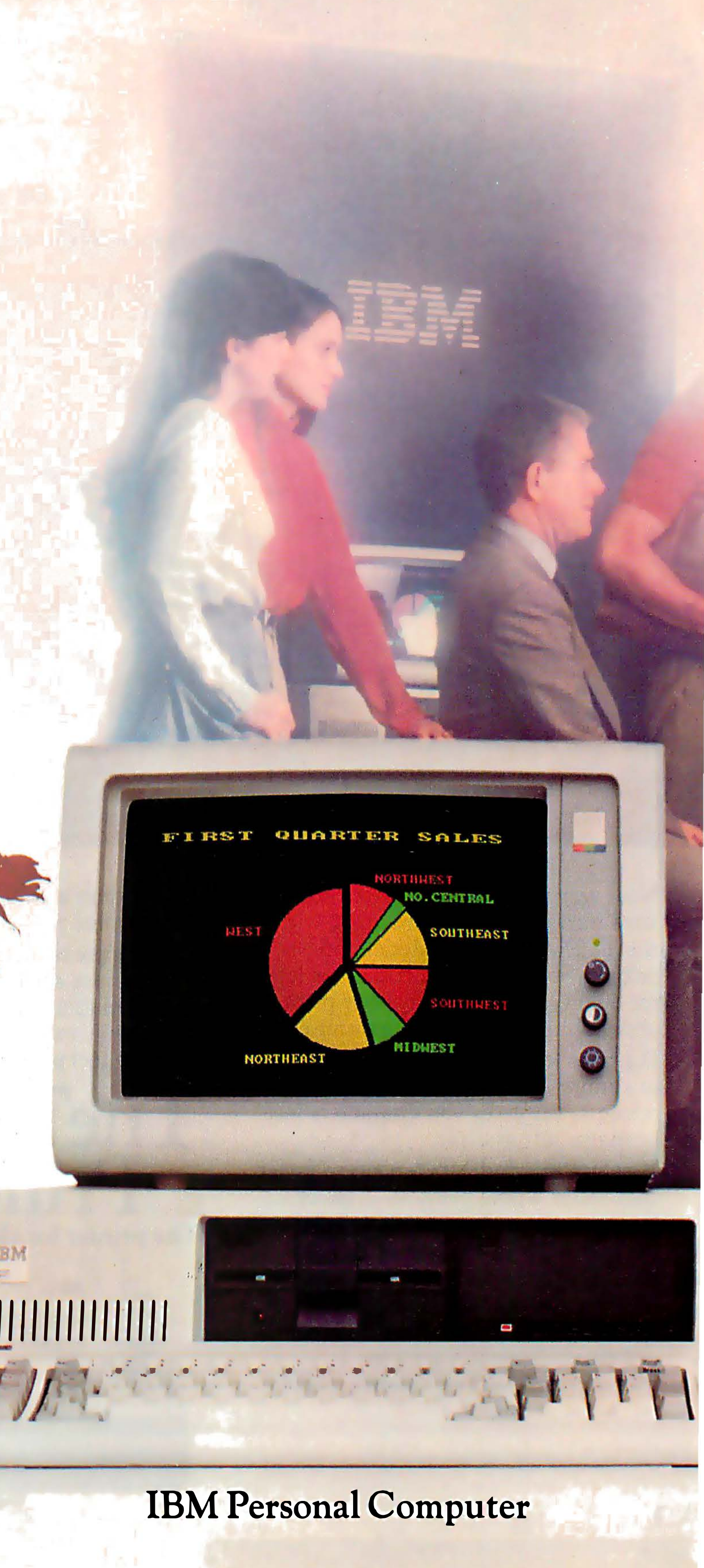
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DTC 2763-69-R1

Data Collection with an IBM PC

This letter concerns your May article by Stephen C. Gates, "Laboratory Data Collection with an IBM PC" (page 366). I am writing to correct some errors I found in the article and to explain some inadequacies of the Tecmar LabMaster board.

My first comment is about using a low-pass filter. When doing A/D sampling, a low-pass filter is not just optional but required. This is because of the sampling theorem that says A/D conversion must be done at twice the rate of the highest frequency desired; otherwise the high frequency will fold back into the low frequencies and produce erroneous results. Dr. Gates seems to think that one can oversample and then use software filtering to eliminate noise. Although it may eliminate certain types of noise, software filtering can never correct the aliased signal, and it is dangerous because the result seems clean but may contain low-frequency signals that were never sent by the instrument. The proper way is to use a sharp cut-off filter, reduce the noise in the system, and don't waste space or time by oversampling.

The first step in eliminating noise is sampling, using differential input. In fact, contrary to what the article says, except for measuring DC voltages, single-ended input should never be used. Next, the wires connecting the instruments should be a shielded twisted pair with only one end of the shield grounded. Finally, to avoid having the wires act as an antenna, the DC potential between the instrument and the A/D converter should be minimized. This can be done either by using an isolation transformer in the circuit or by using filters with a DC offset adjustment. However, an isolation transformer changes the phase of the signals in a complicated (nonlinear) way. Using such techniques, I am able to use 12-bit A/D sampling with wires over 40 feet long and keep the outside noise down to less than 1 bit. Thus one should use good filters and low noise connections and not go through software hoopla in a doomed effort to "fix up" a signal.

For the past six years I have been using high-quality A/D and D/A sampling to analyze and synthesize speech on a PDP 11/34, a VAX 780, and, most recently, an IBM PC. We tried the Tecmar board but found it inadequate for our use and had to return it. The board we use now is the Data Translation DT 2801-A and it works very well.

As Dr. Gates observes, it is necessary to turn off the system clock interrupts to avoid missing data even at moderate sampling rates. This fact in and of itself is a clear indication that the Tecmar board is inadequate for the job. Keeping structure in a program or hardware system dictates that one part should not affect another. The Data Translation board, because it has DMA, allows one to sample at over 25 kHz and continue to do disk, terminal, and other I/O without skipping a beat. I have no vested interest in selling the DT board; however, I would like to keep people from making a mistake by trying to use an unsuitable board in their work.

Dr. Gates's article presents many good and useful ideas but misses on some of the most basic ideas of data acquisition. And readers should be aware that data acquisition requires more than just blindly connecting hardware.

John Mertus
Providence, RI

Your letter discusses some useful points about interfacing. I think, however, that you missed one of the central points about the article: the interface I described was designed to be used on a variety of instruments and hence has to be more general purpose than the approach you describe. Indeed, much of what you suggest I have used for several years on a system in my research laboratory dedicated to collecting data from a high-performance liquid chromatograph. The difference is that for a single-purpose system, parameters can be optimized for that single purpose, whereas a more general approach must be taken if the computer is to be interfaced to several instruments, each of which has its own frequency of collection, noise characteristics, etc. It would be difficult to suggest a single set of filters, isolation devices, etc., that would suffice for all of these instruments. For example, what is a low-pass filter for one device may turn out to completely eliminate the signal of interest from another.

However, for dedicated applications of the type you describe, your comments are largely correct. For such applications, I would highly recommend to the user that he or she consult a more complete reference on the topic, such as Electronics and Instrumentation for Scientists *by Malmstadt, Enke, and Crouch (Benjamin/Cummings, 1981). The considerations that you mention are just a few of the many that are described in that text and others. For example, Malmstadt et al. recommend band-pass, rather than low-pass, filtration as a preliminary step but still suggest the need for software filtering, such as Fourier transform-based filtration. Indeed, the reduction of noise by various techniques is different for almost every case and often requires considerable experimentation before the desired result can be achieved.*

I think that you overstate the case for direct memory access (DMA) devices. While they are useful, particularly for high-speed applications, they are gathering dust in many labs where they were purchased for low-speed applications. In any case, in a single-user system, I do not consider the necessity of turning off the clock for a few milliseconds or even a few seconds to be a major problem. I suspect that if you had turned off interrupts before using the Tecmar LabMaster at high speeds, your feelings about it would be quite different. However, I certainly did not mean to imply in my article that the LabMaster would satisfy all users; fortunately, there are several manufacturers and a variety of options on each board that allow the user to select the board most suitable to her/his needs.

Stephen C. Gates, Ph.D.
Normal, Illinois

A BYTE Apology

Regarding your May issue on computers and the professions—your cover artwork makes me wonder. Are there no women

(continued)

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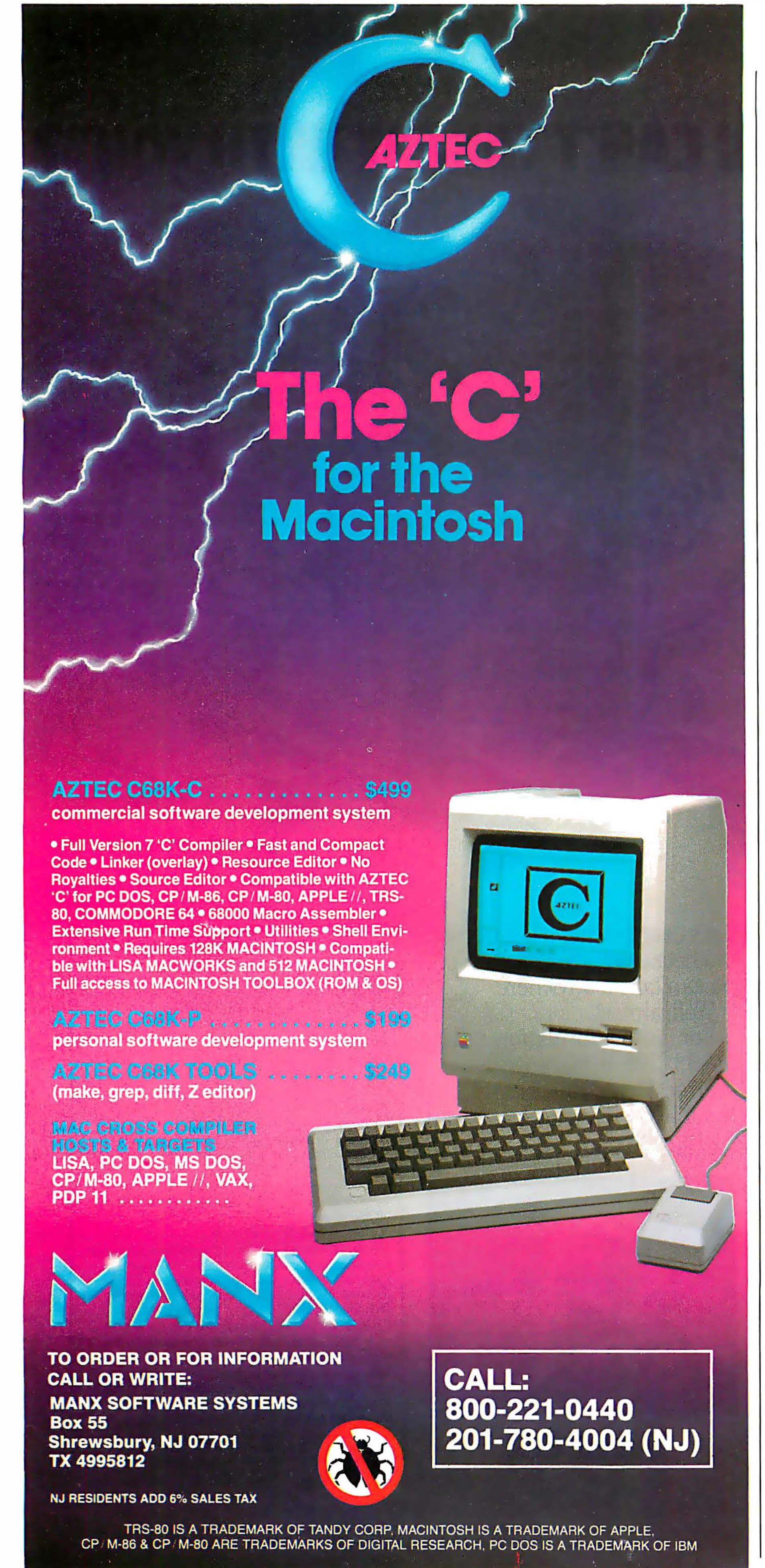
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**MS DOS is a registered trademark of Microsoft.



judges? Are there no women doctors/scientists? Are there no women contractors in construction? Are there no women surveyors? Are there no women professional types? (For the word "women" you can also substitute "black," "handicapped," or any minority. I am a white female.)

In other words, are all professionals white, male, storybook characters?

CAROL J. BUECHLER
Kettering, OH

Clearly we goofed, and we apologize.

RE: THE SIMPLEX ALGORITHM

The article by Marco S. Caceci and William P. Cacheris ("Fitting Curves to Data," May, page 340) was excellent—clear, lucid, and a big byte in the direction of better numerical software for microcomputer users. Using the authors' flowchart (figure 4 on page 346) I was able to write a routine in BASIC for the Radio Shack Color Computer that takes under 3K bytes. By replacing the sum of squares criterion by $(-2)\times$ the log likelihood, the algorithm obtains maximum-likelihood solutions (rapidly) to problems that SPSS on the local Cyber 170/720 cannot touch (logistic regression, unbalanced random-effects models, etc.). For the first time I appreciate the power of the home computer.

For other BASIC programmers, I would like to make a couple of remarks to speed up the program. On each iteration, the first step should be finding and storing the sum by columns of the parameter values in the Simplex (i.e., a multiple of the centroid of all the points). The values of the reflected, extended, and contracted points may then be written down without any IF statements. Second, both the best and worst vertices have to be found only initially and after shrinking all vertices toward the best. If the expanded or reflected vertices are accepted, then only the new worst has to be found. If the contracted vertex is used, then either it or the previous best is best and, again, only the worst has to be found. In the flowchart, the question of termination cannot be examined until the new best and worst vertices are known.

In the Michaelis-Menten example, when holding parameter a fixed, to determine standard errors (see below), negative (inadmissible) values of parameter b sometimes occurred. Following the authors' suggestion, I added Booleans to the sum of squares criterion, i.e.,

(continued)

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Roger Scaggs
President, APS Systems, Inc.
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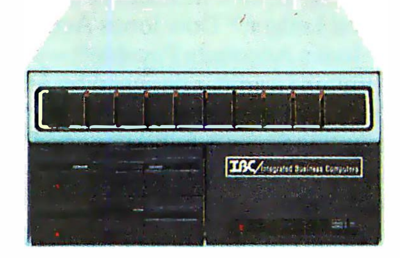
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$C = C - (A \leq 0) \times 1000 - (B \leq 0) \times 1000$

(the Color Computer returns −1 for true statements). This appears to be a technique superior to the so-called "penalty" methods, especially when, as in random-components models, zero is admissible and minima may occur on the boundaries.

In many experimental situations, the standard errors are not of great interest; the usual interest is in comparing the values taken by the criterion, both when the unrestricted model is fitted and when (some of) the parameters are fixed at certain prestated values, such as zero. If the values of the criterion under these two situations are C_1 and C_0, respectively, then when the sum of squares is used, the F-test has the value $F = (C_0 - C_1) \times (n-r)/(C_1 \times p)$ with p, $(n-r)$ degrees of freedom, where n is the total number of observations, r is the total number of parameters fitted (for C_1), and p is the number of parameters constrained (for C_0), $0 < p \leq r$. If $(-2) \times$ log likelihood is used as the criterion, then for medium to larger samples the corresponding chi-square test is $X = C_0 - C_1$ on p degrees of freedom. If $p = 1$, the square root of F, or X, is the usual t (with n−p d.f.), or Z, statistic when the appropriate sign is attached.

In nonlinear problems the standard error varies as the value of the parameter varies. If (a_1, b_1, c_1) is the minimum point, take a fixed at $a_0 = a_1 - d$, where d is "small," and find the new constrained minimum, say (a_0, b_0, c_0). The standard error of a is roughly d divided by t, or Z.

J. B. Garner, Ph.D.
Halifax, Nova Scotia, Canada

"Fitting Curves to Data" highlights splendidly one of the major deficiencies of Pascal.

Back in my college days I grumbled if I had to use FORTRAN for these purposes. I had to take care of libraries for friends and then link the main program (plus necessary routines) with the code that described the model function (and its gradient). No wonder I always preferred the slowly chugging BASIC version on the HP 9830 to the blitzkrieg version in FORTRAN that ran on the Cyber. At least the users were not on my heels all the time.

Now, in Pascal you have to recompile everything, not just relink, when the model function changes. I hear comments that the version x of y compiler, interpreted on z, can support separate compilation. As far as I understand, Pascal is Pascal as defined by Niklaus Wirth (thank goodness for that at least). And I saw no hopeful words

(continued)

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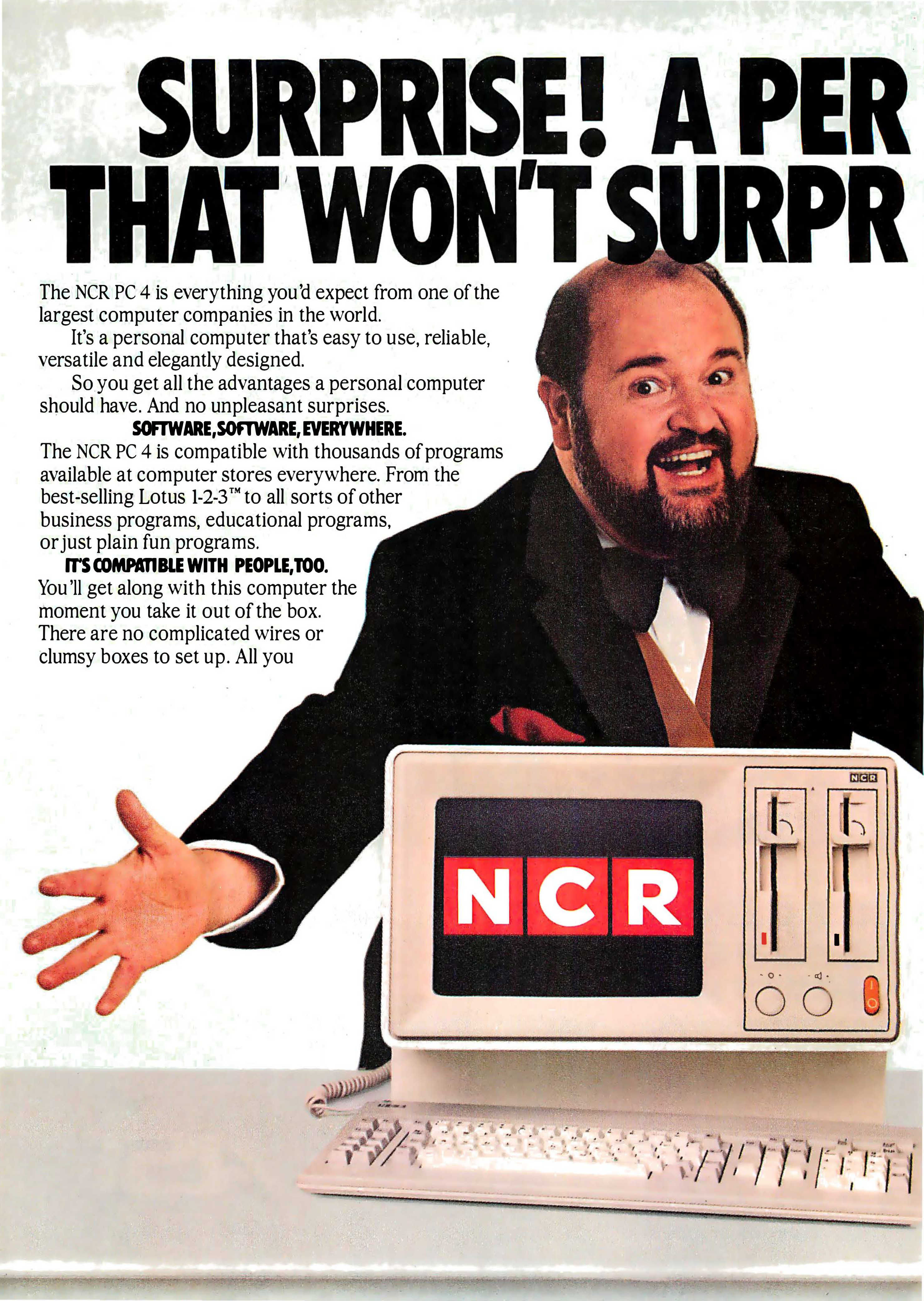
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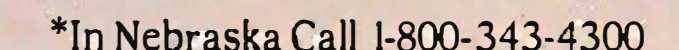
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about separate compilation there.

Has anybody given any thought to the possibility that there are cases where a part of the problem changes from user to user? So (again) a part of the code has to change, but just a part—three or four lines, or less than 1 percent. Why not have something like comlink . . . end comlink in the main program, which would read the input file and compile instead of compute?

Well, in the meantime I will stick to interpreters. They are getting faster.

VITO SMOLEJ, PH.D.
Don Mills, Ontario, Canada

ID PROGRAM

Thanks for the Subscriber Identification Card. It is a valuable part of my subscription. Presented in listing 1 is an IBM Macro Assembler program that will display your number on your terminal when BYTE is entered from DOS. If you don't have a color/graphics adapter or CONFIG.SYS with DEVICE = ANSI.SYS, just delete the color statements and it will display in black and white.

ALEXANDER V. PINTER
Columbus, GA

ENTHUSIAM FOR APL AND LOGO

Thank you for publishing Fred Masterson's article "Languages for Students" (June, page 233).

I have been using APL since the late 1960s and, although I routinely use about a dozen languages, I use APL or Logo unless there are overwhelming reasons to do otherwise. I have often tried to explain why I do this to other programmers and I have found that the reaction I get is either instant enthusiasm or total rejection. Before reading Mr. Masterson's article, I had decided that discussing the value of APL and Logo is like discussing the price of a Rolls-Royce: If you need to ask the question, the answer is probably beyond your means. Mr. Masterson has provided a clear and concise explanation.

There is an extension to Mr. Masterson's discussion that is worth mentioning: Most expert programmers have a stock of idioms (chunks of code that are used so often that they have become as automatic as primitives) that are major contributors to their high productivity. The APL programmer's stock of idioms tends to be richer, more concise, and much more powerful. Another advantage is that many idioms are handled like icons. They are used and read like pictures or single symbols (the APL "teepee" commonly used for handling leading and trailing elements of a vector is an excellent example); something that is not possible with the lengthy, multiple-line idioms of more primitive languages.

I was also delighted to learn about AMPL. The first APL I used was on the SDS Sigma 7, which included mnemonics for ordinary ASCII terminals. I have had many opportunities to regret the loss of

Listing 1: *The Subscriber Identification Number Macro Assembler program.*

```
        ;--------------------------------------------------------------
;BYTE — Displays Subscriber Indentification No.
        ;--------------------------------------------------------------
CSEG    SEGMENT
BYTE    PROC    FAR
        ASSUME  CS:CSEG
START:  PUSH    DS
        PUSH    AX
        MOV     DX,OFFSET MSG + 100H
        MOV     AH,9
        INT     21H
        RET
MSG     DB      27,'[36m'           ;CYAN
        DB      13,10,'ALEXANDER V. PINTER'
        DB      27,'[31m'           ;RED
        DB      13,10,'SUBSCRIBER IDENTIFICATION '
        DB      27,'[33m'           ;YELLOW
        DB      13,10,'NUMBER xxxxxxx',13,10
        DB      27,'[32m$'
BYTE    ENDP
CSET    ENDS
        END     START
```

this capability and I hereby volunteer for any reasonable task the creators of AMPL would like to assign me that will assist in the promulgation of this language and its availability on as many mainframes as possible.

MARC THIBAULT
Mississauga, Ontario, Canada

THE KELLER PLAN

Stephen Chorover's article "Cautions on Computers in Education" (June, page 223) was marred by a serious error of fact as well as several questionable interpretations. Prior admission that he is presenting a caricature does not excuse the mistakes in description and interpretation. The "Keller Plan," developed by B.F. Skinner's best friend and colleague Fred Keller, is a teaching method that enhances student learning by (1) behavioral analysis of the responses to be acquired so that an appropriate sequence of learning exposures is planned, and (2) intensive interaction between the student and the teachers and proctors. This method did not involve automation. Moreover, like Mark Twain's famous reply to his obituary, reports of the plan's demise are greatly exaggerated. Pennypacker and his colleagues at the University of Florida have developed an individualized instructional system along the lines described by Keller that has not only successfully taught less able students in lower division courses, but also has helped them acquire the general reading and study skills that permitted over 80 percent of them to graduate.

That application illustrates the same lesson that some of the early, less-successful teaching-machine experiments also showed. The materials ("software") with which the student interacts are more important than the machine that presents them. Successful applications await both an adequate understanding of what's involved in learning (as Keller's reinforced learning procedures do) and the investment of time and testing the Florida group contributed to make the materials work.

LEWIS R. GOLLUB
College Park, MD

THREADED-SUBROUTINE INTERPRETED LANGUAGE

It was a pleasure to read Ronald L. Greene's article "Faster FORTH" in the June issue (page 127). I struggled with the same conflict of speed versus utility in designing an application program. After reading Ronald Loeliger's *Threaded Interpretive Languages* and articles on Warnier-Orr diagramming by David A. Higgins, et al. (in *Programming Techniques*, volume 1; *Program Design*, Byte books; and *Program Design and Construction*, Prentice-Hall) and comparing the goals of using a threaded interpretive language with the microprogramming of the 8088, I decided to use a threaded-subroutine interpretive language. My initial attempts at a fast inner interpreter appeared much the same as Dr. Greene's (see listing 1 on page 420). I even tried to speed things up by adding hashing and token address tables. Not having read the BYTE article by Terry Ritter and Gregory Walker ("Varieties of Threaded Code for Language Implementation," September 1980, page 206) I did not know that a threaded-subroutine (or subroutine-threaded) method of language implementation was good practice, but I tried it anyway.

For my application, and for transport to other computers (e.g., the Macintosh, which has almost 500 subroutines in its ROM) from the IBM PC, the threaded-subroutine method appears to be optimum; my apologies to FORTH users. This does not detract from the major goals of a threaded interpretive language but is simply an alternate method of implementation.

Thank you for printing Dr. Greene's article. It was nice to see someone else confirming my experiments.

RICHARD DOUGLAS GREEN
Los Angeles, CA

MACINTOSH PASCAL VERSUS WATCOM PASCAL

I would like to bring to your attention a fact that must have escaped G. Michael Vose, judging from what he wrote in his article "Macintosh Pascal" (June, page 136).

For two years I have used an interpreted version of Pascal to teach the language. On the same computer, I have used interpreted FORTRAN, again in an introductory course on the language. After seeing a microcomputer spend several minutes compiling simple Pascal and FORTRAN programs, I had begun to be very pessimistic about the prospects of teaching FORTRAN and Pascal on microcomputers because the students would be lucky to be able to enter, debug, and run even very simple programs within an hour. Then I was able to try a Commodore

(continued)

SuperPET, with its interpreted BASIC, FORTRAN, Pascal, APL, and COBOL. These interpreters were written by Waterloo Computing Systems Limited and I understand they are now available for the IBM PC as well as the SuperPET.

While these interpreters do not offer the windows as Macintosh Pascal does, they do offer single stepping in the debugging mode, as well as the ability to add breakpoints in the program and to display values of variables, and to change their values during these breaks.

I share Mr. Vose's enthusiasm for interpreted Pascal for learning the language. I cannot, however, join in his congratulating Apple for "introducing" something that has been around for some time.

DOUGLAS H. UNDERWOOD
Walla Walla, WA

Mr. Underwood is correct in pointing out that the former Waterloo Computing Systems' interpreted Pascal (formerly called microPascal) is an earlier version of interpreted Pascal than Macintosh Pascal. He errs in claiming that I credited Apple with "introducing" an interpreted Pascal. I said only that Macintosh Pascal is a "significant new Pascal product."

Watcom (the company's new name) Pascal has languished in obscurity since its 1980 release mostly because of its target market—the education industry. Watcom Products Inc. also produces interpreters for APL, BASIC, FORTRAN, and COBOL. These language systems run on IBM 370 mainframes, DEC VAXes, DEC Pro 300 series machines, Commodore SuperPETs and 64s, and IBM PCs. The FORTRAN and COBOL interpreters offer only subsets of the languages (primarily because of memory limitations) and are intended strictly for educational purposes. Compilers for the mainframe versions of COBOL and FORTRAN are available, but no BASIC or Pascal compilers are available through the company.

In fact, company president Ian McPhee claims that Watcom Products' market is solely the "post-secondary education market" and that the company does not advertise in consumer markets or distribute its products ouside the educational mainstream. Commodore and IBM are the only microcomputer manufacturers selling Watcom's products. Commodore bundles all five languages with the SuperPET and IBM sells the five Watcom languages plus a micro-to-mainframe link called Waterloo PC Network as a package through its personal computer education division.

McPhee claims an installed base of 25,000 Watcom Pascal systems on microcomputers. An IBM PC version of the language costs $250 while a Commodore 64 version lists for $150. Quantity central-processor-unit licenses are available to educational institutions.

For further information, contact Watcom Products Inc., 158 University Ave. West, Waterloo N2L 3E9, Canada.

G. MICHAEL VOSE
BYTE Features Editor

MACGROANS REFUTED

The press is alive with the sounds of MacGroans.

David Nibbelin (June Letters, page 14) objects to subsidizing the Japanese

(continued)

economy by using its parts in Macs. (Find me a computer with all American-made parts, Mr. Nibbelin.)

Susan Gold (June Letters, page 33) can't see the Mac as a productivity aid.

Everyone is having hysterics about the lack of Mac software.

Well folks, I say sour grapes and fie upon you! I have had my own (as opposed to company-owned) Mac for just over two months now and my valuation of it is still growing. It rides back and forth to my office with me, through Washington traffic, shoulder-harnessed and seat-belted in the passenger seat three or four days a week.

I'm "suffering," along with the thousands of other Mac users, from the inferred "awful burden" of only three useful tools: MacWrite, MacPaint, and Microsoft Multiplan. Instead of a burden, I find these three tools can handle 90 percent of my daily information-processing requirements. The secretaries in my daytime office are estatic because they don't have to type from my scribbles anymore, and my weekly and monthly status reports are now on time, coherent, and edited when they get them.

All of my production organization charts and other business graphics that used to go through an iterative process at a local high-priced graphic arts firm, now come out finished the first time and ready to paste into product documents.

My project-cost accounting and projection is all done in about 10 minutes a week and presented to management in a far superior form and content than I could find time for pre-Mac. Project planning milestone/resource schedules are a snap with Multiplan (now that the more serious flaws have been patched).

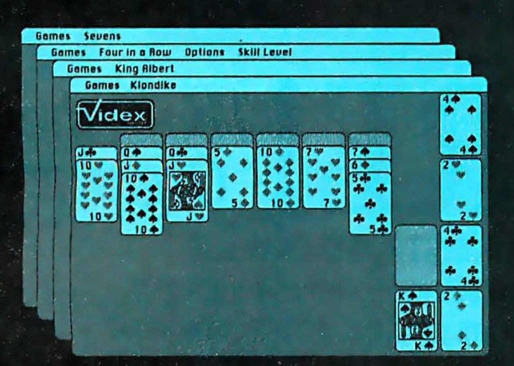
Presentation-quality overhead transparency material with variable fonts and classy-looking text/graphics go directly from my Imagewriter to the transparency format on our office copier and then to the conference-table projector, untouched by an artist's or secretary's hands. Our valuable secretarial staff now have a partially new lease on life, doing more with their heads and less with their fingers, at least with respect to my material.

Sure, I have outstanding orders at my helpful Apple dealer (Falcon Systems Inc., of Bethesda, Maryland) for MacDraw and MacProject as well as for Microsoft Chart, but those are frosting on the already delicious cake. For business, for me, Mac is already a success.

When the Applemodem/MacTerminal combination arrives, I will be able to trans-

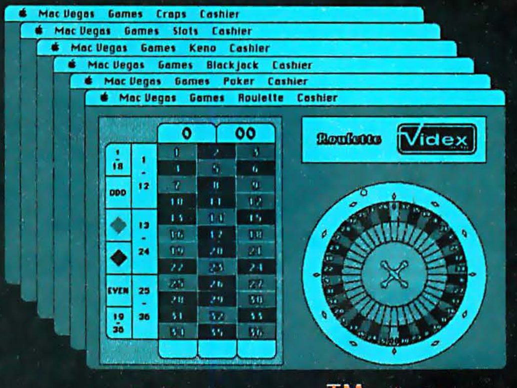
(continued)

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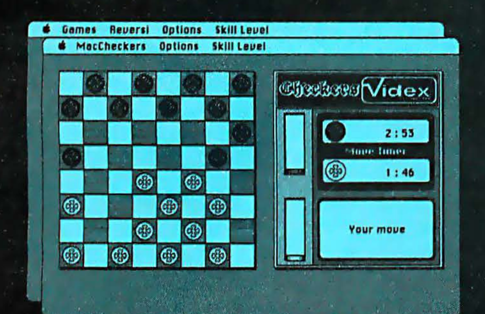
FunPak™– $39

Klondike Solitaire · King Albert Solitaire · Four in a Row · Sevens



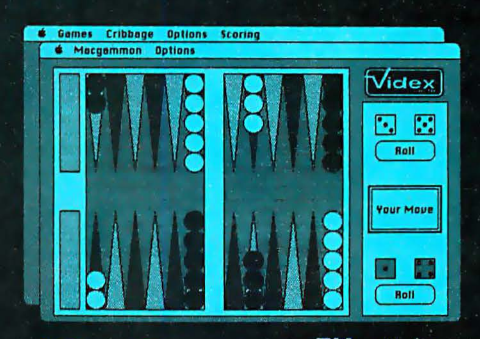
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"SIDEKICK IS A $50 SOLUTION TO A $5,000 PROBLEM."
Garry Ray, PC WEEK, July 24, 1984

mit my text output directly into our office word processor through the modem from my desk at the office, at home, or on the road. Nothing new or earthshaking to the initiated, but I suspect the Mac will rapidly widen the initiated ranks.

As well as being a senior technical manager for TRW Inc., I have my own boat agency at home. A couple of MacWrite files handle my PR material/mailing list sufficiently well that I am pleased with the results. Pricing of a custom set of options for a boat customer takes only a few minutes using a combination of Multiplan and MacWrite to create a neatly printed, signed, formal quotation.

My kids do homework on the Mac.

My wife has some of her professional material on MacWrite documents.

While the Mac is my first personally owned computer, I have been in the computer business since 1965. I have daydreamed about a user interface like the Mac's often. I recognized my daydream machine, or a close facsimile thereof, as soon as I palmed my first Macintosh mouse. I ordered instantly.

My company DP department is pushing the PC XT. I looked it over and found it a poor buy for me. It's a long way behind the Mac in interface philosophy. The diehard MS/PC-DOS experts mesmerized by the IBM logo can have it. I prefer to communicate directly with my software's capabilities rather than through a middleman translation protocol.

Despite the software delays and numerous phone calls to Microsoft to report bugs and find out my Multiplan version 1.02 *still* hasn't arrived, I have no regrets.

Anyone who bought a Mac expecting a mature stable of software this year hasn't enough experience in the computer business to be seriously voicing publishable complaints. I note with interest that Jerry Pournelle has been relatively silent on the issue. I suspect that's because he has enough experience to wait until the product is more mature before commiting his time to evaluate it.

The competition has been printing largely inaccurate reviews of prerelease Mac software; many of them seem like rewrites of producers' public-relations material rather than valid, in-use evaluations. I have several prerelease programs and they are bug-ridden as well as incomplete. I'm hanging in there and waiting for the production stuff to appear on retail shelves. That's when the payoff comes, and I'm not interested in promises of the Real-Soon-Now family.

(continued)

Circle 351 on inquiry card. ⟶

In the Hard Disk Jungle Tallgrass Clears A Path

In today's hard disk jungle, Tallgrass clears a path by offering high performance, integrated mass storage solutions for the IBM® PC/XT, the T.I. Professional and related computers.

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If anyone is interested in an owner's advice, read the Cary Lu book and the Clegg book, and then run, don't walk, to your nearest Apple dealer and get your order in. Even if you are one of the thundering herd with IBM engraved inside your eyeballs, you won't be sorry.

And to the software developers whose product ads state only "for IBM and compatibles," I say: Wake up folks, there's another large, hungry, and growing market out here that you would do well to service!"

And to Susan Gold: My thanks for reminding me that there are toy aspects to the Mac. I had almost forgotten in my daily use of the Mac that it's fun to use.

I have no trouble telling where the insertion point is located despite bifocals. I find editing with the mouse to be a joy compared to the old Xerox, DEC, and Wang word-processor methods I struggled with in the past.

My government customers have been enthusiastic recipients of the graphics in our deliverables already, and we have just begun. Onward and upward with Project, Chart, Draw, and da Vinci! The Mac is a productivity aid—and a very cost-effective one.

BILL MONROE
Fort Washington, MD

I am writing in response to Susan Gold's letter, which appeared in the June issue. Ms. Gold uses the example of deleting a single character to establish the inefficiency of the Macintosh's mouse. The same analogy could be applied to the automobile: It would be inefficient indeed to use an automobile to go to your next-door neighbor's house.

Ms. Gold has, obviously, given the Macintosh a cursory inspection and has not used it to the point an owner would (at which time use of the mouse becomes second nature). Many editing functions *can* be called from the keyboard (if you want to memorize the commands). In short, the mouse provides the operator the freedom of choosing which mode to use. In fact, I usually do use keyboard commands. But, unlike the VAX I use at work, if I haven't been on the machine for some time I don't find myself having to pull out the owner's manual to rediscover some obscure editing command.

The Mac is not just a toy. It is as powerful or more powerful than any micro on the market I know of priced under $5000. Ultimately, like any machine, the Mac will only be as good as its software. As business applications software becomes available for the Mac, I am sure it will be at least competitive with the IBM machines in speed, capability, and efficiency, and superior in ease of operation.

JOHN BICKNELL
Lawton, OH ■

LETTERS POLICY: *To be considered for publication, a letter must be typed double-spaced on one side of the paper and must include your name and address. Comments and ideas should be expressed as clearly and concisely as possible. Listings and tables may be printed along with a letter if they are short and legible.*

Because BYTE *receives hundreds of letters each month, not all of them can be published. Letters will not be returned to authors. Generally, it takes four months from the time* BYTE *receives a letter until it is published.*

F·I·X·E·S A·N·D U·P·D·A·T·E·S

BYTE's Bugs

Bugs Sneak Through Sieve

A pair of bugs slipped through the Sieve of Eratosthenes benchmark program that complemented Rich Krajewski's review of the Chameleon Plus (June, page 327).

The Sieve benchmark in listing 1 (page 334) and listing 2 (page 336), beginning with 5 REM: THE SIEVE... and ending with 180 PRINT..., is incorrect as it appears. Cut and paste listing 1 as presented here.

We apologize for the error.

Listing 1: *The corrected version of the Sieve of Eratosthenes benchmark program for the* IBM PC *and* Apple IIe.

```
5 REM:  THE SIEVE BENCHMARK
10 SIZE = 7000
20 DIM FLAGS(7001)
30 PRINT "start one iteration"
40 COUNT = 0
50 FOR I = 0 TO SIZE
60 FLAGS(I) = 1
70 NEXT I
80 FOR I = 0 TO SIZE
90 IF FLAGS(I) = 0 THEN 170
100 PRIME = I + I + 3
110 K = I + PRIME
120 IF K > SIZE THEN 160
130 FLAGS(K) = 0
140 K = K + PRIME
150 GOTO 120
160 COUNT = COUNT + 1
170 NEXT I
180 PRINT "done: ";COUNT;" primes
      found"
```

Sorry, Wrong Numbers

A pair of incorrect telephone numbers appeared in recent issues of BYTE.

The telephone number given for Multimate in the review published in the BYTE Guide to the IBM Personal Computers was incorrect. The correct number is (203) 522-2116.

In the August 1984 BYTE on page 308, the telephone number for the SIGSTAT (Special Interest Group for Statistics) bulletin board was incorrectly listed. It should have read (301) 596-3569. Please note that the board's hours are 5:30 p.m. to 9:30 a.m.

We apologize to all who have been inconvenienced.

Feedback

Controlling Legalities with Editors

Legal difficulties forced us to alter the program listing of the videodisc game that accompanied the article "Controlling Videodiscs with Micros," by Rod Daynes and Steve Holder (July, page 207). It seems, however, that in our editing process we took all the flavor out of the program.

Messrs. Daynes and Holder's program is based on timing computer commands to disc frames. By replacing the frame numbers with a purely sequential series of numbers, we completely undermined the program's logic. The authors would like to offer a listing that retains the intent of the original to anyone interested in more than a mere vanilla version. For details, write to Rod Daynes or Steve Holder, Interactive Technologies Corp., 1131 G St., San Diego, CA 92101.

Show of Interest to Videodisc Community

Steven D. Bristow, director of Technicom Design Center Inc. in Mountain View, California, sent us an update to a table in Stan Jarvis's article "Videodiscs and Computers" (July, page 187).

Under the heading "Information Sources and Conferences" in table 2 on page 190, please add the annual International Conference on Consumer Engineering. This conference, which features technical papers of interest to the videodisc community, is sponsored by the Consumer Electronics Society of the IEEE and is held in conjunction with the Consumer Electronics Show. The venue is Las Vegas, early in January.

Further information on the show can be obtained from the Consumer Electronics Shows Office, Suite 300, 2001 Eye St. NW, Washington, DC 20006, (202) 457-8700. The IEEE can be contacted at POB 639, Silver Spring, MD 20901, (301) 921-3491.

Magnetic-Stripe Card Stores 2K Bytes

Vertex Industries markets a magnetic-stripe card and card reader/writer with a storage capacity of 2K bytes, according to a letter we recently received from Jim McMenamey, Vertex's product marketing manager. This information refutes the 212-byte limit claimed by Mark Mills in his January article "Memory Cards: A New Concept in Personal Computing" (page 154).

Vertex's product, called the KB-32, is being used in machine-tool and health-care fields. The company is located at 23 Carol St., POB 1123, Clifton, NJ 07014-1123, (201) 777-3500.

BYTE's Bits

Call for Papers

Two calls for papers recently arrived at our office.

The organizing committee for the Ninth Annual Western Educational Computing Conference seeks papers that deal with computers and computer applications in any area that might interest instructors and administrators at the college level. The conference is to be held in Oakland, California, in November 1985, under the sponsorship of the California Educational Computing Consortium.

The deadline for submissions is April 1, 1985. Send two copies of original papers to Dr. Virginia S. Lashley, Glendale College, 1500 North Verdugo Rd., Glendale, CA 91208.

The Popular Culture Association will hold its annual meeting from April 3 to 7, 1985, in Louisville, Kentucky. One session will explore the question: Can computer adventure games be considered literature? They are, after all, built from words, and many of them have complex plots, characters, and settings.

A lively discussion is expected. If you're interested, contact Dr. Peter Jordan, School of Arts and Sciences, Tennessee State University, 10th and Charlotte, Nashville, TN 37203.

(continued)

Modify the Sanyo Drives' LEDs

Frans J. Janson, a BYTE reader in Santa Barbara, California, sent us directions for modifying the LED indicator used in the Teac drives built into the Sanyo MBC 550 series computer. Normally, the LED lights on the active drive and stays on until the drive's operation is completed. Mr. Janson's modifications change the LED operation so that it lights only when a drive access or an attempted access is taking place. The rest of the time the light is off.

Here's how you do it: Disconnect the power supply and remove the computer's top cover. Figure 1 (presented here) represents your work area; it's located on the top right-hand quadrant of the printed-circuit board on each drive. Next, locate and cut the trace on the printed-circuit board as indicated in the figure. Install the components listed in table 1. (Note that no wires are needed, that the lead length on the parts used is adequate, and that the lead length may need to be shortened for some connections.)

Make sure that there are no solder bridges or splashes that can cause a short. Component leads that are too close or that are touching something will also cause a short. Reconnect the power supply and check for satisfactory operation before replacing the cover.

Swiss Finance Center for Computer Music

The Swiss government agreed to finance a Swiss Center for Computer Music last May. Situated in the picturesque village Oetwil am See near Zürich, the center is the brainchild of Gerald Bennett, Rainer Boesch, Dr. Antonio Greco, and Bruno Spoerri.

The Center provides facilities for visiting and local composers, and sponsors concerts, workshops, and courses in computer music. It's equipped with a MicroVAX, two PDP 11/17s, and a DMX-1000 signal-processing computer.

Future plans call for a second studio to be located near Geneva and international summer courses for composers having previous experience in some area of computer music. For more information, contact Schweizerisches Zentrum für Computermusik, Sommerau, CH-8618 Oetwil am See, Switzerland. ■



Table 1: *List of components needed for modifying the Teac drives.*

Number Required	Part Description
4	2N4401 silicon NPN transistors
6	1N4148 silicon diodes
4	10K-ohm, ¼-watt resistors

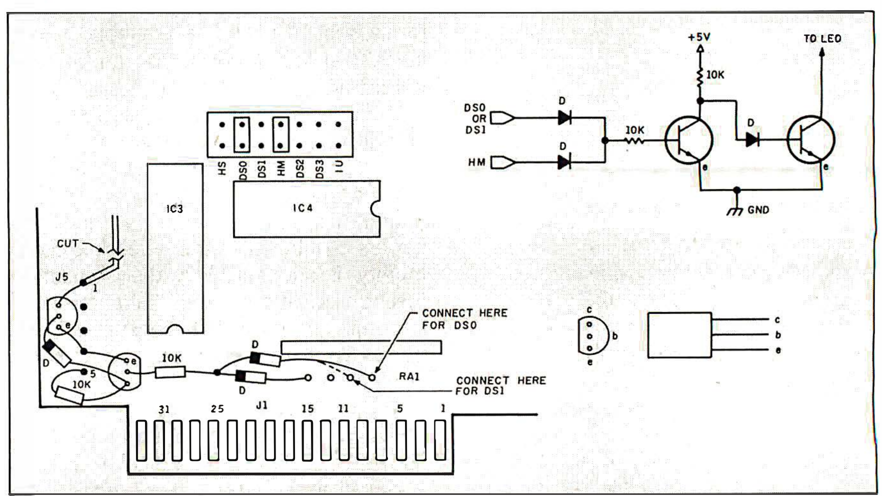


Figure 1: *Work area for modifying the operation of the LED indicators on the Sanyo's Teac drives.*

UDS gives 212 users three ways to go!

212A — Today's most popular modem. UDS offers a fully Bell-compatible unit with complete local and remote test capability. Select 0–300 or 1200 bps for full-duplex asynchronous communication. The UDS 212A is FCC certified for direct connection to the dial-up telephone network, and available in multichannel, rack-mounted configuration.

SINGLE UNIT PRICE **$595**

212 LP — Compatible with 212As at the 1200 bps, full-duplex asynchronous communication rate. No power supply or AC connection required; the 212 LP derives its operating power directly from the telephone line. Ideal for applications requiring 212A capability at 1200 bps only. The 212 LP is direct-connect certified.

SINGLE UNIT PRICE **$345**

212A/D — Identical to the 212A, with automatic dialing capability added! The unit stores and dials up to five 30-digit numbers. CRT menu prompting, single-stroke commands and automatic test capabilities are provided. The 212A/D is direct-connect certified.

SINGLE UNIT PRICE **$645**

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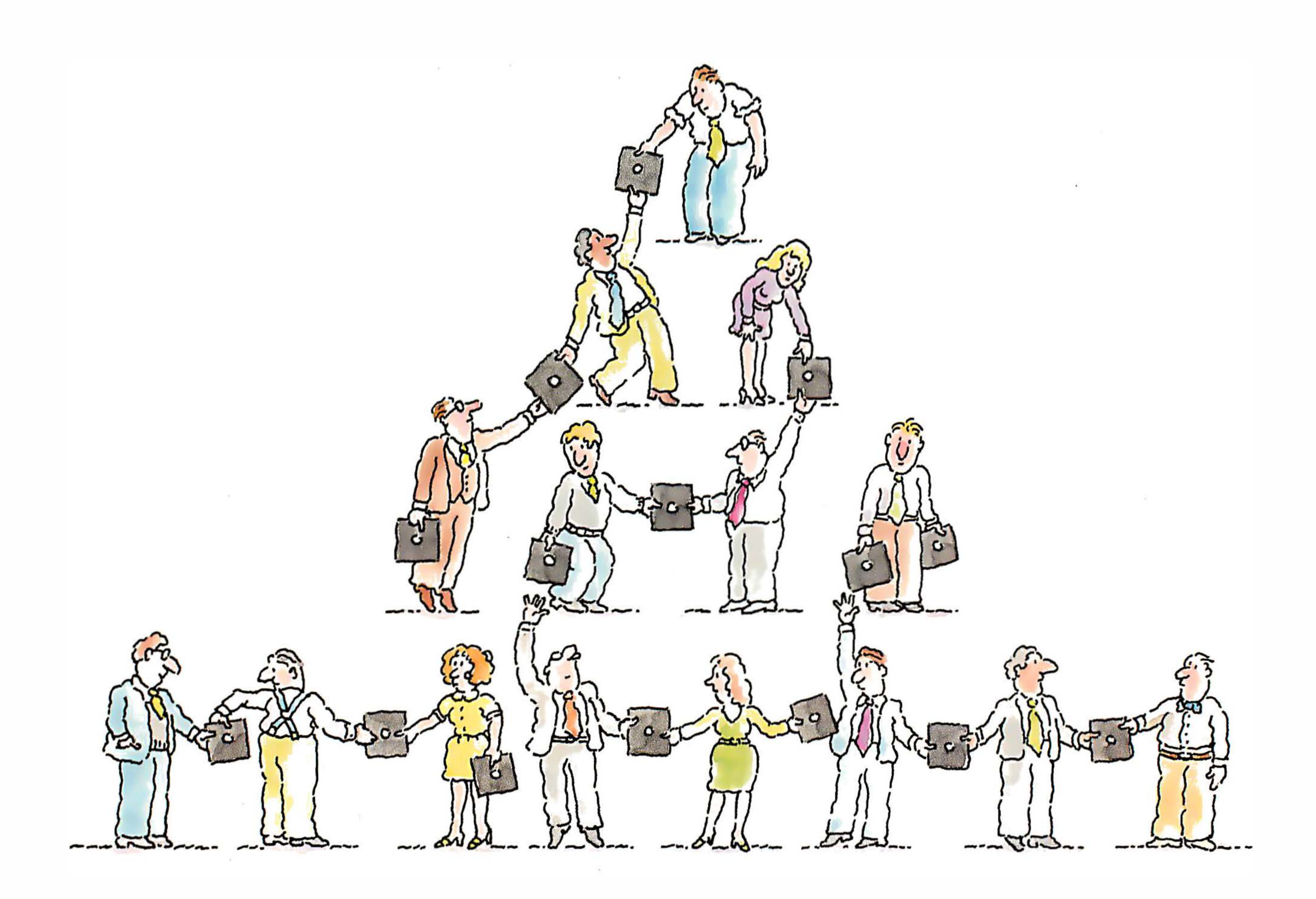
5000 Bradford Drive, Huntsville, AL 35805. Telephone 205/837-8100; TWX 810-726-2100

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Created by Dayner/Hall, Inc., Winter Park, Florida

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THE END OF SOFTWARE FREEBIES.



Finally there's a foolproof way to protect software against unauthorized duplication. And the technology is all on the disk itself.

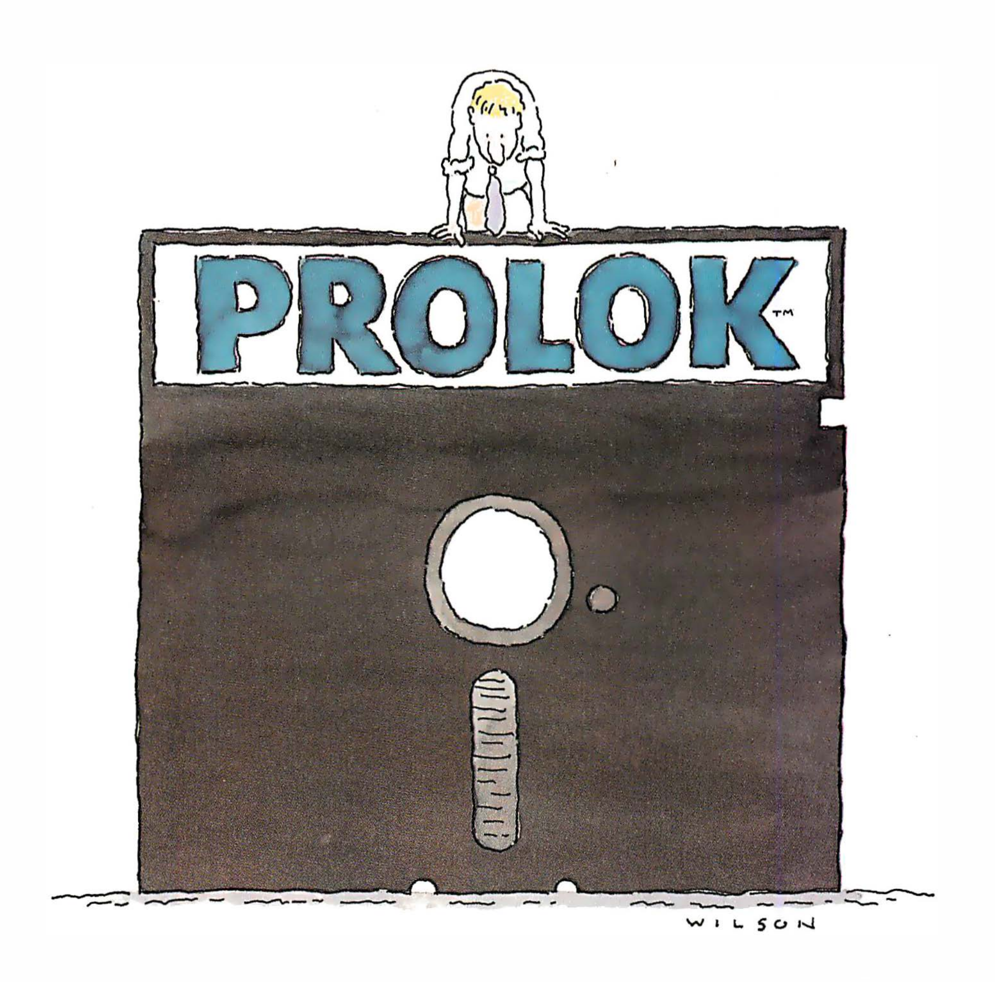
The new Prolok™ disk doesn't need add-on hardware. Instead each diskette is marked with a unique, physical "fingerprint." No two are alike. A precise description of the individual print is encoded magnetically. The fingerprint AND the description must match exactly before the software is decrypted and released to the system. No match, no access.

Its genius is its simplicity and familiarity. Prolok looks like an unprotected disk, loads like an unprotected disk, works like an unprotected disk. The user feels immediately at home and in command. It's as easy as A>PROLOK B: filename.

Backups are easily made via normal system utilities. However, to be read they must be accompanied in the system by the original Prolok disk.

Prolok puts the casual copier—and even the deliberate pirate—out of business. It barely

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increases the price of your product, yet it makes sure your customers don't buy one program and copy ten.

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Software can be loaded easily onto Prolok diskettes using any system from a PC to commercial mass duplication equipment.

Prolok is an engineering breakthrough of Vault Corporation, which has been successfully safeguarding software since the inception of security disk technology. Over 2000 businesses and organizations protect their valuable programs with Prolok.

Simply contact Vault Corporation at 2649 Townsgate Road, Suite 500, Westlake Village, CA 91361. Or phone us at 800-445-0193 (U.S.) or 800-821-8638 (California). And find out why software freebies are becoming a thing of the past.



PROTECTION, RIGHT ON THE DISK.

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Circle 217 on inquiry card.

AI System Runs Smalltalk-80, Priced Less Than $15,000



Tektronix's 4404 Artificial Intelligence System runs Xerox's Smalltalk-80. The 4404 generates an interactive integrated software environment that supports simultaneous program design and implementation. Reportedly, the 4404's architecture, when coupled with Smalltalk-80's sophisticated graphics interface, is so responsive that on-screen animation can be realized.

Tektronix, one of four major companies selected by Xerox in 1980 to evaluate Smalltalk, announced that the 4404 with Smalltalk-80 will sell for $14,950. Shipments are to begin after the first of the year. Smalltalk was the topic for the August 1981 issue of BYTE.

Smalltalk-80 creates an integrated exploration and development environment. An object-oriented language, it facilitates the invention of large, complex systems by letting programmers defer many constraints and commitments until the overall framework has been defined.

Smalltalk-80 works with symbolic descriptions of objects and incorporates such concepts as classes and messages. Routines can be executed immediately upon definition, and Smalltalk's internal definitions are available through windows.

The basic 4404 is a desktop unit built around the 10-MHz 16-/32-bit Motorola 68010 microprocessor. Floating-point operations are supported through a hardware accelerator. Mass storage is provided by a 20-megabyte hard-disk drive and a 5¼-inch floppy-disk drive. User memory comprises 1 megabyte of RAM, which can be expanded to 2 megabytes. Page-on-demand memory management produces an 8-megabyte virtual address space, which permits development of complex programs without segmentation or overlays.

A 13-inch bit-mapped monochrome graphics display operating at 60 Hz, noninterlaced, is standard equipment. The display format is 640 by 480 pixels, which serves as a window into the 1024 by 1024 display address space. Smooth panning over the entire display area is featured. A mouse completes the user interface.

The 4404 has Centronics-type parallel, RS-232C, and SCSI interfaces for connections to host computers and peripherals. In addition, an ANSI X3.64-compatible terminal emulator furnishes immediate access to other computers.

An Ethernet networking interface will be ready in the spring. Optional languages available include Franz LISP and Prolog. A 40-megabyte hard disk with streaming-tape backup is also offered. For further information on the 4404 Artificial Intelligence System, write on company letterhead to Tektronix Inc., Marketing Communications Dept., Mail Station 63-635, POB 500, Beaverton, OR 97077.

Circle **600** on inquiry card.

Expert System Capabilities for the PC XT

TIMM (The Intelligent Machine Model) is an expert system for the IBM PC XT that has been ported from mainframes. It is written in FORTRAN, a reflection of its mainframe origin. Minimum hardware requires an XT with 512K bytes of RAM and an 8087 mathematics coprocessor chip.

In operation, TIMM organizes information into sets of specific rules. These rules are then generated into general rules, which are used by the program to solve problems. A certainty factor is produced at the same time as a solution. The program also will explain, if asked, how it reached a decision by listing the rules used to make the decision.

TIMM costs $9500. Call for an on-line dial-up demonstration. Contact General Research Corp., POB 6770, Santa Barbara, CA 93160-6770, (805) 964-7724.

Circle **601** on inquiry card.

(continued)

32-bit Computer Series Has Networking Abilities

Sage Computers has changed its name to Stride Micro and introduced a new series of multiuser microcomputers. The Stride 400 series is made up of three base units ranging in price from $2900 to $8900.

The Stride 420 is the series' vanguard. Its foundation is a VME-compatible bus and a 10-MHz 68000 microprocessor. True vectored interrupts, asynchronous operation, a 24-bit address bus that can address 16 megabytes, and optionally polled I/O are standard bus attributes. The 68000 performs 2.5 million operations per second; it has 16-bit data paths and 32-bit registers.

System memory comprises 256K bytes of parity RAM, expandable to 512K bytes, 4K bytes of battery-backed CMOS RAM, and 16K bytes of boot/debugger ROM. One or two floppy-disk drives each manage 640K bytes worth of your data.

Liaison software and the Omninet interface provide access to a file server. The local-area network has a 1-million-bps transfer rate and uses a twisted-pair cable. Stride 420 can accommodate four users, run concurrent operating systems, and serve as a communications hub through Liaison.

Four serial RS-232C ports with data rates spanning 300 to 38,400 bps and a Centronics-type parallel port connect peripherals to the 420.

System software includes the p-System, a screen-oriented editor, filer, utilities, multiuser BIOS, RAM disk, and communications. Software options such as CP/M-86K, P-DOS, APL, BASIC, FORTRAN, and LISP are offered. A floating-point processor is also optional.



Photo 1: *The Stride 420 is the base model of Stride Micro's Series 400 microcomputer. Stride Micro was formerly known as Sage Computers.*

The Stride 440 comes with 256K bytes of RAM, expandable to 2 megabytes. One floppy-disk drive, a 10-megabyte Winchester, and 10 RS-232C serial ports are standard. It can handle up to 16 users. A streaming-tape backup and UNIX V are optional.

Up to 22 users can be linked to the Stride 460. Some of its additional features are a VME card cage, space for up to 3 megabytes of RAM, 10 to 22 serial ports, and Winchester storage capacities that range as high as 448 megabytes.

A Stride 420 with two disk drives and 512K bytes of RAM would cost $3900. The top-of-the-line Stride 460 with one 640K-byte floppy drive, a 40-megabyte Winchester, 2 megabytes of RAM, and a streaming-tape backup is $18,300. For further information, contact Stride Micro, 4905 Energy Way, Reno, NV 89502, (702) 322-6868.

Circle 602 on inquiry card.

Xerox Demonstrates AI System Linked to IBM PC Peripherals

Xerox recently demonstrated an interface option for its 1108 AI workstation that provides connections for third-party peripherals designed for use with the standard IBM Personal Computer extension card cage.

Pricing for the 1108 interface was not available at press time. A company spokesperson did, however, say that shipments will begin in the first quarter of 1985.

At the press conference, Xerox demonstrated two different ways in which the 1108 can be used with IBM PC peripherals. The first presentation showed how a low-cost color monitor can be used with the 1108; the other displayed an analog-to-digital speech input scheme running with the 1108.

The Xerox 1108 AI workstation is a single-user system. It has a large-format, high-resolution display, keyboard, mouse, and Inter-LISP-D. A variety of memory, processor, and disk-drive configurations are offered. It's marketed by Xerox Special Information Systems, Xerox Artificial Intelligence Systems Business Unit, 250 North Halstead St., POB 7018, Pasadena, CA 91109, (818) 351-2351.

Circle 603 on inquiry card.

S-100 Board Features 80186 and Z80 Processors

The Duplex 816 is a dual-processor, S-100 board from Tarbell Electronics. Standard hardware includes an 8-MHz Z80H microprocessor, an 8-MHz Intel 80186 microprocessor, a floppy-disk interface, the 4K-byte 2732A PROM with monitor, two RS-232C serial ports with full handshaking, an interrupt handler, and memory-management capabilities for up to 16 megabytes.

The Intel 80186 features 16-bit registers and data paths. The Z80H is the 8-MHz version of the Z80.

The disk interface can accommodate up to four 8-inch drives and four 5¼-inch drives at once. The system BIOS can read CP/M-86 disks formatted on the IBM Personal Computer. The Duplex 816 has provisions for an 8087 coprocessor, which is not yet available in an 8-MHz version.

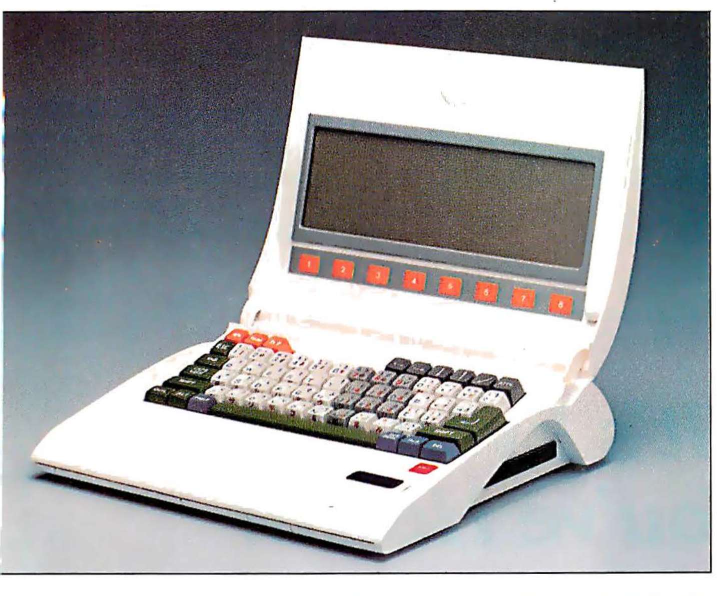
A complete system can be created with the Duplex 816 and a memory board. A manual, BIOS and XIOS drivers for CP/M-86 and MP/M-86, and cables are included in the package, which sells for $1100. Contact Tarbell Electronics, 950 Dovlen Place, Carson, CA 90746, (213) 538-4251.

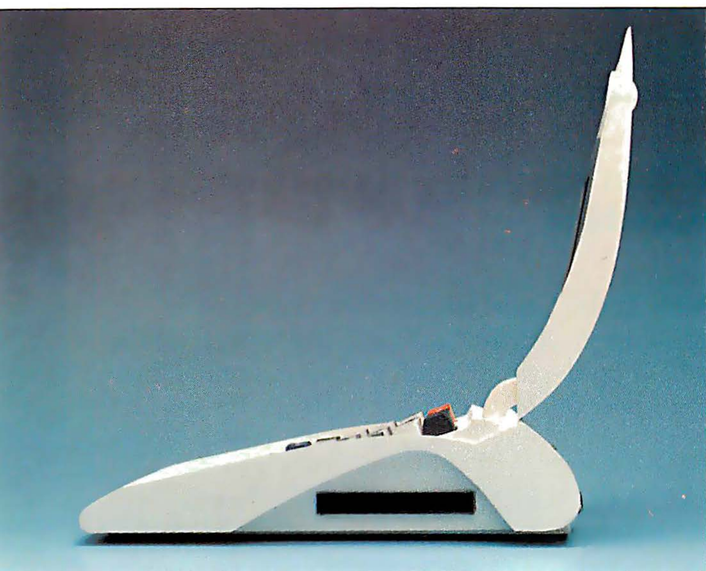
Circle 604 on inquiry card.

(continued)

Lap-sized Big.APL Is Multitasking, Multiuser

A lap-sized computer running APL has been introduced by the Japanese manufacturer Ampere Inc. The Big.APL is constructed about the 8-MHz, 16-/32-bit HD68000 microprocessor and is said to possess all the functions, expandability, and flexibility of a desktop microcomputer.





Its basic hardware is 64K bytes of battery-backed CMOS RAM, 128K bytes of system ROM, a full-sized keyboard with programmable function and command keys, a 16-line by 80-column LCD screen, a real-time clock/calendar, and a built-in, 300K-byte microcassette storage unit.

Big.APL runs an adaptation of the APL.68000 Interpreter, known as APL.63000, under the control of the Big.DOS operating system. APL.63000 is a full implementation of IBM APL.SV that's been enhanced with a component file system, alpha report formatting, text handling, and full-screen editing capabilities.

A multitasking, multiuser operating system, Big.DOS lets you execute two tasks concurrently. It provides multiwindow control and supports multiple character sets for APL and applications programming. Simultaneous program execution and interaction with an external network can be achieved with Big.DOS.

The LCD screen uses a bit map with a 480- by 128-dot resolution and two frame memories. The microcassette tape recorder can be used for storing data and as a call recorder for automatic transmission/reception of both voice and digital information. Both ROM and RAM file areas are user-definable, and data in the file areas is retained on power-off.

Expansion possibilities begin with the Big.APL's two-channel RS-232C serial interface; one of the channels serves as the built-in modem port. A parallel printer interface and three slots for plug-in CMOS RAM, ROM, and EPROM cartridges are supplied. An external bus offers room for such optional equipment as floppy- and hard-disk drives, memory units, and Ethernet interface.

Among the other options available are up to 256K bytes of RAM and an integrated software package with a full-screen function, I/O editor, word processor, graphics, and data manager.

The Big.APL weighs 6 pounds and measures 11.8 by 11 by 2.9 inches. It's powered by nicad batteries or by an AC adapter. Power is switched on and off by opening or closing the case. The main Big.APL unit costs $1495. Each 64K-byte CMOS RAM cartridge is $500, and the 1-megabyte microfloppy disk is $500. Contact Ampere Inc., Asahi Building, 5-20, Nishi-Shinjuku 7-Chome, Shinjuku-Ku, Tokyo, Japan; tel: 03-365-0825; Telex: J33101 AMPERE.

Circle 605 on inquiry card.

Card Lets PC Read/Write Apple Disks

Vertex Systems' Apple-Turnover permits direct file transfers between Apple and IBM Personal Computer disks, eliminating serial-file transfers and modems.

The Apple-Turnover package contains a half-sized printed-circuit board, disk-drive attachment cable, supporting software, and a test disk. The board can be installed in any IBM PC slot between the regular controller card and the PC's disk drives. The test disk assures proper installation and operation.

The file-copying process is straightforward. You insert an AppleDOS 3.3 or Apple CP/M disk into the IBM, follow Apple-Turnover's menu instructions, and copy individual or complete disks of Apple or IBM files. Blank disks can be formatted within the IBM for use on the Apple.

Apple-Turnover requires a 128K-byte IBM PC or PC XT with two disk drives and MS-DOS. Most hard-disk drives are supported. It sells for $279.50. Contact Vertex Systems, Suite 3, 6022 West Pico Blvd., Los Angeles, CA 90035, (213) 938-0857.

Circle 606 on inquiry card.

(continued)

NEW PRODUCT NEWS FROM TELETEK

Systemaster II. Responding to market demand for speed and increased versatility, Teletek is proud to announce the availability of the next generation in 8-bit technology — the new Systemaster II! The Systemaster II will offer two CPU options, either a Z80B running at 6 MHz or a Z80H running at 8 MHz, 128K of parity checked RAM, two RS232 serial ports with on-board drivers (no paddle boards required), two parallel ports, or optional SCSI or IEEE-488 port. The WD floppy disk controller will *simultaneously* handle 8" and 5¼" drives. A Zilog Z-80 DMA controller will provide instant communications over the bus between master and slave. Add to the DMA capability a true dedicated interrupt controller for both on-board and bus functions, and the result is unprecedented performance. Systemaster II will run under CP/M 3.0 or TurboDOS 1.3, and fully utilize the bank switching features of these operating systems.

SBC 86/87. As the name indicates, Teletek's new 16-bit slave board has an Intel 8086 CPU with an 8087 math co-processor option. This new board will provide either 128K or 512K of parity checked RAM. Two serial ports are provided with individually programmable baud rates. One Centronics-compatible parallel port is provided. When teamed up with Systemaster II under TurboDOS 1.3, this 5MHz or 8MHz multi-user, multi-processing, combination cannot be beat in speed or feature flexibility!

Teletek Z-150 MB. Teletek is the first to offer a RAM expansion board designed specifically for the Z-150/Z-160 from Zenith. The Teletek Z-150 MB is expandable from 64K to 384K. Bring your Z-150 up to its full potential by adding 320K of parity checked RAM (or your IBM PC, Columbia, Compaq, Corona, Eagle, or Seequa to their full potential). The Teletek Z-150 MB optionally provides a game port for use when your portable goes home or a clock/calendar with battery backup!

Evaluate the Systemaster II, SBC 86/87 or Teletek Z-150 MB for 30 days under Teletek's Evaluation Program. A money-back guarantee is provided if not completely satisfied! All Teletek products carry a 3-year warranty.

(Specifications subject to change without notice.)

EXTRA! TELETEK TIMES EXTRA!
NEW! SBC 86/87, SYSTEMASTER II, 128K, 6/8MHz AND Z-150 MB

TELETEK

4600 Pell Drive
Sacramento, CA 95838
(916) 920-4600
Telex #4991834
Answer back — Teletek

Circle 353 on inquiry card.

In Europe:
Kode Limited
Station Road
Calne, Wiltshire
SN11 OJR England
tel: 0249-813771
telex: 449335

In Canada:
MAE Microsystems
8255 Mountain Sights, Ste.150
Montreal, Quebec
H4P1W1 Canada
tel: 514-341-1210

SBC-II
SYSTEMASTER
HD/CTC

Yes, I'm interested in information regarding:
- ☐ Systemaster II
- ☐ SBC 86/87 ☐ Z-150 MB
- ☐ Evaluation Program
- ☐ Teletek's S-100 Board Line

Name ____________
Company ____________
Address ____________
____

10B

Multiprocessor Mega PC Supports up to Eight Users

Corona Data Systems Mega PC multiprocessor, multiuser microcomputer gives your office shared integrated system processing and stand-alone IBM PC XT-compatible processing. The power supply, mass-storage units, and peripheral connections for up to eight workstations are centralized in the Mega PC, and two or more Mega PCs can be networked together using commercial PC-compatible network schemes.

The main unit of the Mega PC contains a file-server board with 256K bytes of RAM and an 8088 microprocessor that oversees all housekeeping chores. Eight of its 11 bus expansion slots can be used for APCs (applications processor cards), which are required for every workstation. Empty slots can be occupied by any IBM PC peripheral card. An APC board contains a serial port and a dedicated 8-MHz 8088-2 microprocessor and



256K bytes of user RAM.

A workstation consists of a monitor and an 83-key keyboard. The 14-inch green-phosphor display has a 640-by 400-pixel resolution. Coaxial cables are used to connect users with the central file server.

The Mega PC has two modes of operation: stand-alone IBM Personal Computer-compatible processing and shared resources. Different users can operate under either mode concurrently, with each user being assured of password and read/write protection and the ability to access system resources.

System resources also incorporate a hard-disk controller with a real-time clock/calendar, a 10-, 20-, or 40-megabyte Winchester hard-disk drive, a 16K-byte ROM BIOS that boots the hard disk, and single serial and Centronics-type parallel ports.

Bundled software includes MS-DOS, GW BASIC, and a productivity package. A second 10-, 20-, or 40-megabyte Winchester drive, a 10-megabyte removable-cartridge Winchester drive, and a 43-megabyte streaming-tape backup are optional.

A two-user Mega PC with 256K bytes of RAM and a 10-megabyte hard-disk drive sells for $7805. Additional workstations are $1495, including an APC card. For more information, contact Corona Data Systems Inc., 275 East Hillcrest Dr., Thousand Oaks, CA 91360, (805) 495-5800.

Circle 607 on inquiry card.

Chess Computer Has 10 Levels of Play

Conchess, a chess-playing computer, offers challengers five levels of play, five levels of practice play, and two levels of game analysis. At tournament level 4, Conchess has an estimated British Chess Federation performance rating estimated between 140 and 155. Its automatic sensory recognition lets you move pieces in a normal manner; a keyboard is not required.

You can replay completed games from its memory or reenter a game at any chosen position. It does not permit illegal moves, but it will suggest the best move if you're stuck. For novices, Conchess will show all legal moves for each piece, impose time limits, referee a game between two players, and play against itself. It even lets you take back a move.

The average response time at the practice level ranges from 5 seconds to 30 minutes. At the tournament level, response time averages between 5 seconds and 3 minutes 45 seconds.



Conchess uses the 6502A chip, backed by 24K bytes of ROM and 4K bytes of RAM. Both the hardware and software are packaged in a plug-in cartridge. Two cartridge spaces for new programs and an additional port for future peripherals are standard.

The Conchess playing board is rosewood and mahogany marquetry, silver and black, or silver and copper. It costs from £179 to £279, depending on model. Contact Contemporary Chess Computers, 2-3 Noble Corner, Great West Rd., Hounslow, Middlesex TW5 0PA, England; tel: 01-5771700; Telex: 932905 LARCH.G.

Circle 608 on inquiry card.

(continued on page 473)

Circle 360 on inquiry card. →

BUYING A PASSWORD™ MODEM CAN SAVE YOU UP TO $250. AND THAT AIN'T HAYES!*

You can bank on it. Your outlay will be less than if you settle for our major competitor, but not your output! A Password™ modem sends and receives up to 120 characters per second. Provides both 1200 and 300 baud capacity. Offers total interchangeability that lets you transmit information from any make microcomputer to any other make. And your investment is protected by a 2-year warranty.

Unlike our major competitor, Password™ delivers operating simplicity, plus the convenience of uncommon portability. Thanks to lighter weight, it goes almost anywhere. And because of the ingenuity of Velcro™ strips, it attaches wherever you need it, from the side of a desk to the side of a computer!

This means that Password™ doesn't tie you down, and its price won't hold you up. It features auto-dial, auto-answer, and even knows when to disconnect. If you're cost conscious, but refuse to sacrifice high-speed capability and performance, hook up with the right modem—Password™. The smart decision.

PASSWORD™
by U.S. Robotics, Inc.



USR™

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Chicago, IL 60607
Phone: (312) 733-0497
Outside Illinois:
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*Based on suggested retail price comparisons of U.S. Robotics, Inc. and Hayes Microcomputer Products, Inc.

Introducing the new United they stand.



Programs in IBM's Assistant Series are like actors in a play. Alone, each gives an outstanding performance. Together, they've been directed to act well as a troupe. (In the software world, this interaction is called "integration.")

Just as actors can easily perform on different stages, these programs can easily work on different IBM personal computers — from PC*jr* to larger systems like PC/XT.

How integrated software works.

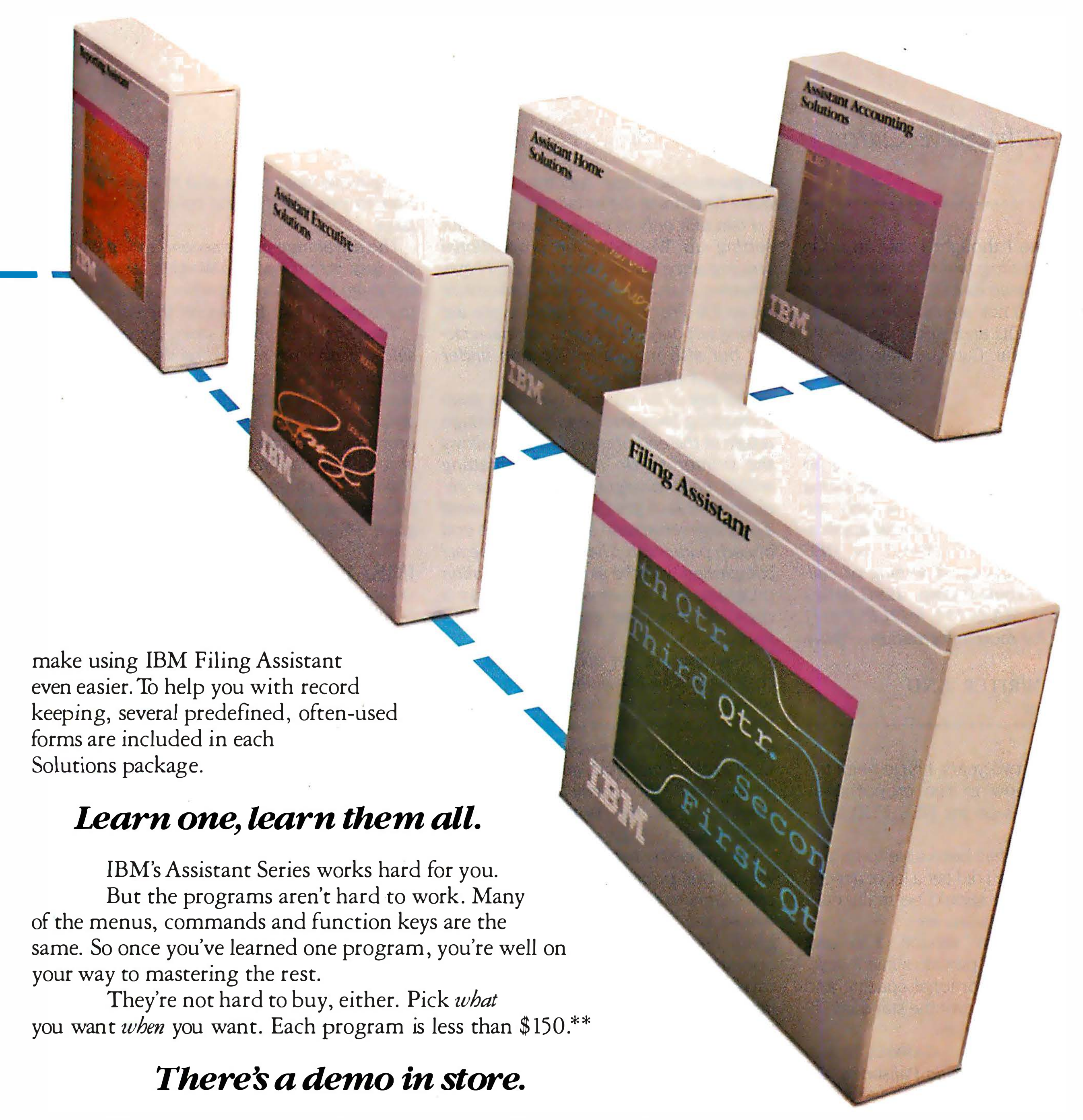
Want to get your facts and figures in order? Start with IBM Filing Assistant. Then, to print the facts in tabular form, add IBM Reporting Assistant. To write about what you've been working on (and make sure the spelling's accurate), use IBM Writing Assistant — the word processing program. Want to put a chart in the middle of your text? Use IBM Graphing Assistant. It takes data directly from IBM Filing Assistant to turn numbers into pictures. When it's time to think ahead with schedules and forecasts — get IBM Planning Assistant,* the spreadsheet program. The finishing touch? IBM Assistant Solutions. They

Little Tramp character licensed by Bubbles Inc., s.a.

*Available early next year.

**Prices apply at IBM Product Centers

IBM Assistant Series. Divided they stand.



make using IBM Filing Assistant even easier. To help you with record keeping, several predefined, often-used forms are included in each Solutions package.

Learn one, learn them all.

IBM's Assistant Series works hard for you. But the programs aren't hard to work. Many of the menus, commands and function keys are the same. So once you've learned one program, you're well on your way to mastering the rest.

They're not hard to buy, either. Pick *what* you want *when* you want. Each program is less than $150.**

There's a demo in store.

We've shown you how affordable the new IBM Assistant Series is. But we can't show you how easy. Your dealer can. Simply ask for a demonstration. For the authorized IBM Personal Computer dealer or IBM Product Center near you, call 800-447-4700. In Alaska or Hawaii, 800-447-0890.

IBM

Personal Computer Software

Circle 168 on inquiry card.

Conducted by Steve Ciarcia

DIBOL

Dear Steve,

At one time I thought I saw an ad in BYTE that said programs written in DIBOL could be run on an IBM PC. PC-DOS would be preferable. If not, any operating system that runs DIBOL and works on the PC would be helpful. Can you help me?

STEVE GENTRY
Richland, IN

A survey of listings in several current system-software publications reveals no mention of the DIBOL language being available on the IBM PC. The only reference to it was for commercial applications using the DEC PDP-11 or DEC VAX-11. I would suggest writing or calling Digital Equipment Corp., 129G Parker St., Maynard, MA 01754, (617) 897-5111 and asking for more information.—Steve

The Spinwriter and WordStar

Dear Steve,

For the past two years, I have been trying to learn how to run proportional-spaced thimbles on my NEC 5510 Spinwriter.

So far, no one has been able to help in any specific terms. I did get a lot of general advice, such as, it should be really easy with the right software, etc.

I have WordStar version 2.10 and wonder if you could provide some instructions to make proportional spacing and the extra characters (over the standard 98) work with my Spinwriter.

GABRIEL BERCZI
Pacific Palisades, CA

Printing the special characters on your Spinwriter requires programming two of the USER printer functions to send the ASCII SO (shift out) and SI (shift in) codes. This switches the printer back and forth between standard and special characters. The SO character, which is ASCII 14, selects the special character mode, and the SI character (ASCII 15) returns to standard type. The USER codes recommended are ^PQ for SO and ^PW for SI. Programming these functions can be done by running the installation program.

I can talk only in general terms about setting up WordStar for proportional spacing since I have never tried it. I have, however, tried the following procedure on an IDS Prism printer. I assume you are talking not only about proportional spacing but also margin justification under control of the printer.

The key is to prevent WordStar from formatting lines and sending a carriage return at the end of every line. This allows the printer to do its own formatting within each paragraph. The other requirement is to get the program to send a carriage return and linefeed at the end of each paragraph. These can both be accomplished with the aid of the installation program, and it seems best to set up a copy of WordStar especially for this purpose.

After you are set up to install a new copy, start the installation program, go to the WordStar features menu, and set the justification default to OFF. Of course, you can also set any other options you want at this time. Next, go to the custom printer installation menu to set up WordStar to allow the printer to control formatting.

There may be two ways to do this: one where the printer decides how many characters to put on a line, and another where the printer just distributes the given line of characters uniformly. To operate in the first mode, go to the carriage-return function in the printer-installation menu and replace the codes there with a 20 hexadecimal (the code for a space). This will prevent WordStar from sending carriage returns at the end of lines. Next, set one of the USER functions to send a carriage return/linefeed pair (0D,0A hexadecimal). You will use this to mark the end of paragraphs.

To operate in the second mode, if it is available, find the code that the printer wants to see at the ends of lines in place of a carriage return. On the Prism, it is ^Z (1A hexadecimal). You will probably also need the 0D,0A hexadecimal USER function as in the first mode also. For both modes, it is necessary to set the margins on the printer and to set WordStar to print in the first column on the page.

The advantage of the second mode, by the way, is that it allows WordStar to control page lengths and numbers and show the correct page breaks on the screen.

This isn't a complete story, especially since it doesn't refer directly to your printer, but I hope it's enough to get you started in the right direction. Don't be afraid to play around with the installation procedure. You can't really hurt anything, as any function you don't like can be changed by running the installation procedure over on the same copy of the program.—Steve

IMSAI Information

Dear Steve,

In the December 1983 Ask BYTE, Gisle Hannemyr inquired about IMSAI manuals. You responded with information about Fischer-Freitas. I thought you should know that Fischer-Freitas is out of business. I bought $1400 worth of hardware from the company for my IMSAI 8080. What I received were wrong parts or damaged parts. I wrote a complaint but received no answer. I called, but the phone was disconnected. I finally received a letter stating that Computer Performance (2479 Industrial Parkway West, Unit F, Hayward, CA 94545, (415) 887-2381) has contracted the repair and warranty work from IMSAI and Fischer-Freitas. I wrote to Computer Performance about the wrong parts, but I again got no answer. Evidently, this is an example of the kind of service that we can expect.

And now a question: How do I get updates to CP/M? I wrote to Digital Research about CP/M patches. While the company was helpful with my other questions, it wasn't able to answer this one.

GEORGE L. MORGAN
Cedar Park, TX

Thank you for your information about Fischer-Freitas and Computer Performance. I will have to store that away for future reference.

(continued)

PRINCETON™
An Intelligent Systems Company

If you're looking for a quality monitor, look for this symbol.

HX-12. A high resolution monitor at a medium resolution price.



HX-12 is a high resolution RGB color monitor that's colorful enough for all your graphics needs and sharp enough for word processing.

With its own cable that plugs directly into the IBM PC, the HX-12 delivers a rainbow of 16 colors on a non-glare screen. All that includes clean whites without red bleed. In fact, all the colors are clean and crisp thanks to the HX-12's .31mm dot pitch and 690 x 240 (non-interlaced) resolution.

Shop around. Nothing else compares to *the HX-12 priced at just* **$695.**

The SR-12 delivers even better resolution color for a better-than-ever price.



At first glance, the SR-12 might appear similar to the HX-12 with a non-glare screen and .31mm dot pitch supporting 690 horizontal resolution. But take a closer look. SR-12's scan frequency is 31.5 KHz, allowing the SR-12 to support 480 vertical resolution in non-interlaced mode. That means a high-quality, flickerless image with text that's up to monochrome standards. What's more, you get all that quality for **$799.**

For full compatibility with all IBM software, get the **Princeton Scan Doubler**. Priced at **$249,** it allows you to run the SR-12 from a standard IBM or IBM equivalent color card in the IBM PC.

You can't beat the SR-12 for resolution or price.

MAX-12. You won't find a better monochrome monitor for a better price.



PGS combines easy-on-the-eyes amber phosphor and exceptional 800 x 350 resolution to give you the MAX-12, the best monochrome monitor for your money.

Check the non-glare screen. Dynamic focusing circuitry keeps the image sharp, not only in the center, but around the edges and in the corners. Then check the price. At **$249** the MAX-12 is less expensive than the leading green-on-black competitor. And there's more. The MAX-12 works with the IBM PC and other IBM compatibles.

For clarity, performance and price, your choice is clear. Make it the new MAX-12.



Princeton Graphic Systems
170 Wall Street, Princeton, N.J. 08540
(609) 683-1660/(800) 221-1490 EXT. 31
Telex: 821402 PGS PRIN

Circle 286 on inquiry card.

It looks like you took the right approach when you wrote to Digital Research. I would try again, but this time write to the newsletter staff at Digital Research News, POB 579, Pacific Grove, CA 93950, (408) 649-3896.

Microsystems *magazine also covers most of the new happenings in the CP/M world. The July/August 1982 issue has an article called "CP/M V2.2 Patches." It is a reprint of a Digital Research article describing CP/M patches 1 through 9. Write to* Microsystems, *One Park Ave., New York, NY 10016, (212) 725-6856.*
—Steve

North Star CP/M

Dear Steve,

I have an S-100-based homebrew microcomputer system that uses a North Star single-sided double-density disk drive. I have been using the North Star DOS and now want to switch to CP/M. I would like to know of sources of CP/M for the North Star and how to customize the operating system for my computer system's I/O. My system uses an S-100 Z80 processor card.

Also, could you please describe the differences between CP/M 2.2 and CP/M 3.0.

Thank you.

George C. Lysy
Palm Harbor, FL

Microsystems *magazine publishes a great deal of material on the North Star systems. In the May 1983 issue, "S.A.I.L.ing Without a Lifeboat," written by Steve Leibson, discusses a version of CP/M 2.2 for the North Star being sold by S.A.I.L. Software. The price is $165. Write to S.A.I.L. Software, 86 West University Ave., Suite 14, Mesa, AZ 85201.*

CP/M 3.0 has many features that CP/M 2.2 was lacking. I will not go into the details of these features, but the following list should give you an idea of some of the new features provided: time and date stamp, multisector disk I/O, device redirection vectors, banked memory access, and disk media change signals.
—Steve

ISAM Facility

Dear Steve,

I wish the popular operating systems like CP/M, MS-DOS, and UNIX had an ISAM (indexed sequential-access method) facility. Compared to the operating systems on minicomputers, the operating systems on micros are abominations. Don't you think

it's time for the microcomputer industry to move forward a step by providing an indexed or symbolic key-access capability for keyed files?

LAMONT PHEMISTER
Mt. Vernon, IL

You're right about microcomputers not having the greatest operating systems in the world, but unless someone writes better ones, we'll be stuck with what we have.

Several companies sell programs that add such features as you've described. For instance, SofTech Microsystems Inc. (16885 West Bernardo Dr., San Diego, CA 92127, (619) 451-1230) sells KSAM for the Apple IIe. This is a keyed-sequential-access-method utility that operates under the p-System operating system. For other companies, check the ads in BYTE or try a software directory.—Steve

MEMORYWRITER

Dear Steve,

I am having a problem with my Xerox 615 Memorywriter. I bought it with an informal understanding that I would be able to use it as a letter-quality printer for a microcomputer. I am now having difficulty getting this accomplished.

I have written Xerox to ask about the feasibility of having an RS-232C port put in my typewriter. I was told that this could be accomplished only by upgrading my 615 Memorywriter to a 620 Memorywriter at a cost of more than $900. I have located several companies that can change IBM electronic typewriters into printers for micros for less than $500. I would appreciate any help you can give me. I am not prepared to spend $900 to upgrade my typewriter into a typewriter with a preview screen and additional memory. I am prepared to spend $500 to convert my typewriter into a machine that could function as my printer.

JOHN C. TOTH
Jackson, MS

Spending $900 is a high price to pay if the only benefit is that the machine can now be used as a printer for your computer. At those prices, it would be better to purchase a dedicated printer for the computer and leave the typewriter as it stands. Daisy-wheel printers with rates of 10 to 15 characters per second are now selling for less than $500. Ads can be found in the advertising pages of BYTE.

(continued)

A new product for transforming electronic typewriters into computer printers is being advertised by Cord Ltd. The product, SuperCord II, is an update of the original SuperCord. The claim is that the SuperCord II can transform typewriters such as Adler, Brother, Royal, Smith-Corona, Silver Reed, etc. into computer printers. Maybe the etc. includes the Xerox machines. The address is Cord Ltd., 2815 Junipero Ave., Bldg. 102, Signal Hill, CA 90806. The price of the SuperCord II ranges from $295 to $365, depending on the model selected.—Steve

MICRO DECISION

Dear Steve,

I have not seen any reviews and/or letters to the editor on the quality/ease of use of the Morrow Micro Decision. Have I missed something? Would you ask users to write in? It seems a shame that the unit isn't covered, since it seems to be a true bargain.

Thank you.

HOWARD BURNS
Diamond Bar, CA

The Micro Decision system looks like a fine CP/M machine from the articles that I have read. The terminal is an ADM 20 made by Lear Siegler, and the keyboard is detached. In the rear of the machine are two RS-232C serial ports and a card-edge connector for the addition of outboard disk drives. Inside the main box are a switching power supply and a single-board computer driven by a Z80. The CP/M BIOS is claimed to be well written and gives meaningful disk error messages. The BIOS also supports a virtual-disk drive that can be used to overcome some of the disadvantages of a standard CP/M system when changing disks.

Reviews of the Micro Decision can be found in the October 1983 BYTE and the February 1983 issue of Microsystems. *A review of Morrow's Decision I can be found in the April 1983* Microsystems.—Steve

UPDATING WORDSTAR

Dear Steve,

Neil G. Wallace's "Full Use of the Epson MX-80 Under Wordstar" (May 1983, page 203) was about the IBM PC and Epson MX-80. I have a Zenith Z-89 64K-byte computer running CP/M and a Star Micronics Gemini-10 printer. I would like to update my version of WordStar, which is version 2.25. I need a step-by-step guide, such as this article. I understand that the Gemini is a clone of the Epson. Where could I go to get this information?

DAVID L. OWSLEY
Birmingham, AL

The procedure for modifying your CP/M version of WordStar is the same as for the IBM PC version. Since you are working with CP/M, however, the debugger is DDT instead of Debug. WordStar is loaded from your experimental disk by entering the command DDT WS.CMD. The detailed procedure is too long to put in a letter, but I will give you the differences from the procedure shown in the May 1983 article.

First, the addresses you will see when you enter the data will look different than those given in BYTE because they won't be in the 8088 segment:offset format. Where the addresses displayed by the IBM PC look like 04B5:0793, you should see just 0793. Second, the addresses used are a little different. You should look in your WordStar installation manual in the "Printer Patch Area" section to check this, but the information I have shows that the "RIBBON" section, which is the first (^PY) place where code is entered, starts at 06DD hexadecimal. Remember that DDT loads the program at an offset of 100 hexadecimal, so you will have to start entering at 07DD hexadecimal, or 004A hexadecimal higher than the offset addresses given for the IBM PC version. This delta should hold for all addresses given. Check the instructions on using DDT in your CP/M manual for details on writing the revised program back onto your disk.

The Gemini-10 is supposed to be Epson compatible, and it is in most respects. The codes given in the BYTE article should work, but when in doubt, go to the manual—the printer manual in this case. Once you get into it, you may find that you can add other printer features to the program.—Steve

FAST FOURIER

Dear Steve,

Would you publish a fast Fourier transform routine for a 6809/68000 or Z80? In case you can't, please tell me who could supply me with this program. I would like to do some applications on random noise and spectral analysis.

GEZA HOLZHAKER
Mérida, Venezuela

(continued)

What Business Can Afford To Use Fuzzy Information?

In this age of information processing, perhaps the most important information processing occurs between your eyes and your monitor screen. An unclear on-screen image can visually distort the most accurate information, leaving valuable information lost somewhere between the lines.

You won't take that chance with a monitor from Roland DG. For us, clarity is not just a good feature, it's our most important feature.

We designed the Roland DG monitors as if a sharp image was all that mattered. Then we start adding on the extras—like easy plug-compatibility, non-glare screen and other features. Then we styled them so that they look sharp from any angle—not just the front.

Roland DG makes a broad range of monitors, to suit any personal computer and to please any computer's person. From high resolution RGB and Composite Color monitors to Monochrome Composite or TTL signal (IBM-PC) in either Amber or Green.

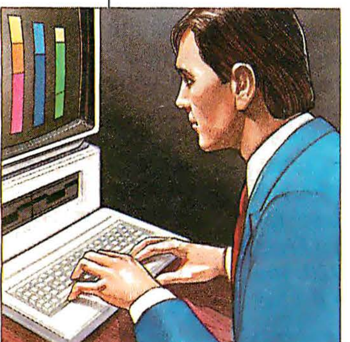
If accuracy is important to you, you shouldn't settle for anything less than a Roland DG monitor—the clear choice. Because the most important information processor is you.

Roland monitors are available at fine computer dealers everywhere. Roland Digital Group, 7200 Dominion Circle, Los Angeles, CA 90040 (213) 685-5141.

MODEL
CC141

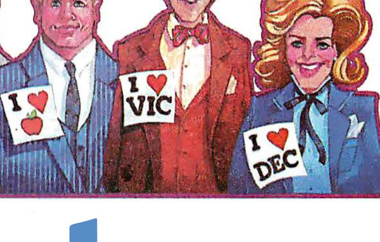


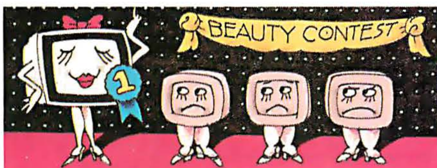
The most important information processing occurs between your monitor and your eyes.





Designed to be as beautiful on the outside as on the inside.





There's a Roland DG monitor for every computer's person!

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Roland DG

Two articles published in BYTE may be of use to you. The first ("Fast Fourier for the 6800," Richard H. Lord, February 1979, page 108) presents a program for the 6800, which is very similar to the 6809; the second article ("Fast Fourier Comes Back," Alastair Roxburgh, May 1981, page 458) discusses an overflow error in the first program and presents an improved program for the 8080. This program will run on a Z80 if your assembler uses the 8080 mnemonics.

EDN magazine is running a series of articles by R. F. Cobb on Fourier transforms, including one with an FFT BASIC program in the March 8, 1984 issue. This program will process 1024 points, but since it is in BASIC it is slow, taking about a second per point. You can obtain a copy of the series by writing to Art Lehman, Cahners Reprint Service, Cahners Plaza, 1350 East Touhy Ave., Box 5080, Des Plaines, IL 60018.

Two sources of information that may be of use to you are Fast Fourier Transform by E. Oran Brigham (Prentice-Hall, 1973) and "A Guided Tour of the Fast Fourier Transform" in the IEEE Spectrum for July 1969. These give routines written in FORTRAN, which should be useful if you have a compiler for one of the processors you mention.—Steve

Exidy Sorcerer

Dear Steve,

I am trying to connect an Exidy Sorcerer microcomputer running CP/M to an HP 150, using the RS-232C connectors and a cable. Could you direct me to software to run on the Exidy to act as a monitor or terminal so that I could pass files between the two systems? I would also like to get software for the Exidy that would allow me to use a modem. So far, I have not been able to get the machines to even talk to each other. Thanks.

Rob Randall
Sunnyvale, CA

The cable you need to interface the two computers is called a null modem. This usually has the connections shown in figure 1.

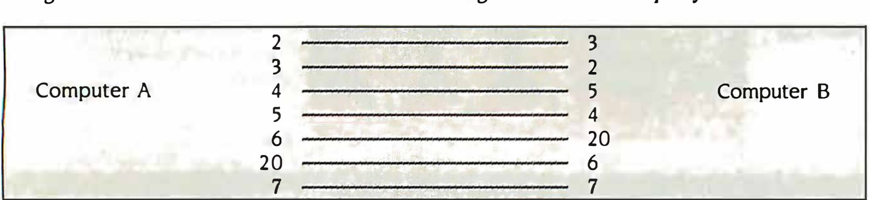


Figure 1: A null modem usually has the connections shown here.

Pins 2 and 3 are DATA OUT and DATA IN, 4 and 5 are REQUEST TO SEND and CLEAR TO SEND, and 6 and 20 are DATA SET READY and DATA TERMINAL READY. You can get by with only pins 2, 3, and 7 if you use the XON/XOFF handshaking protocol, and you may not need the pin 6-20 connections.

Since the HP 150 uses MS-DOS 2, and you are running CP/M on the Exidy Sorcerer, you may be able to pass files between the two computers using a simple communications program in the Exidy and the MS-DOS COPY command in the HP 150. The procedure for setting up the HP 150 is as follows:

1. Open the serial port on the HP 150 using the MODE command, for example: MODE COM1:12,N,8,1,P to open port for 1200 bps, no parity check, 8 data bits, 1 stop bit, and printer mode for continuous retries on time-outs.

2. Set the system up to send a file, say from the B disk drive, with the command COPY B:file.ext COM1:. To receive a file, the command would be COPY COM1: B: file.ext.

Don't press the Enter key until the other computer is ready to go.

You may be able to use the PIP command on the Sorcerer in a similar manner if you have the proper device driver installed for the serial port, but CP/M doesn't seem to be as standardized in this respect as MS-DOS. The command would probably be PIP OUT:= B:file.ext to send to the HP and PIP B:file.ext=INP: to receive a file. To ensure that data will not be lost, you should press the Enter key on the receiving computer first. Be sure to set the serial ports up for the same data rates and protocols on both computers.

If you need to transfer files frequently, you should probably get a communications program for at least one of the computers and preferably both. HP has a versatile program for the 150, the Series 100/DSN/Link. I haven't seen any other communications programs for the HP, but an excellent program is available for the IBM PC. PC-Talk III comes from FreeWare, POB 862, Tiburon, CA 94920. You might write the company and ask if it has or plans to convert the program to the HP format.

On the CP/M side, a lot of communications software is available. One popular program is Crosstalk from Microstuf Inc., 1845 The Exchange #140, Atlanta, GA 30339. Another one that is popular and inexpensive is Modem7 from the CP/M Users Group, 1651 Third Ave., New York, NY 10028. You might also send $3 to SIG/M, POB 97, Iselin, NJ 08830 for its public-domain software catalog. There are probably several communications programs to choose from.—Steve

TI-99/4A Pinout

Dear Steve,

I need the pinout of the TI-99/4A bus so that I can build my own peripherals. I assume your 32K-byte memory expansion for the TRS-80 Color Computer could be slapped right on a TI if someone would come up with the pinout of the TI bus. I tried once and nearly went blind trying. Are there any sources for information such as this? I enjoy your columns and books.

Gerald Applegate
Erie, PA

The pinout for the TI-99/4A is given in the book The S-100 & Other Micro Buses by Elmer C. Poe and James C. Goodwin (Howard W. Sams & Co., 1981).

You can also get a technical manual from Texas Instruments that gives schematics and bus data.

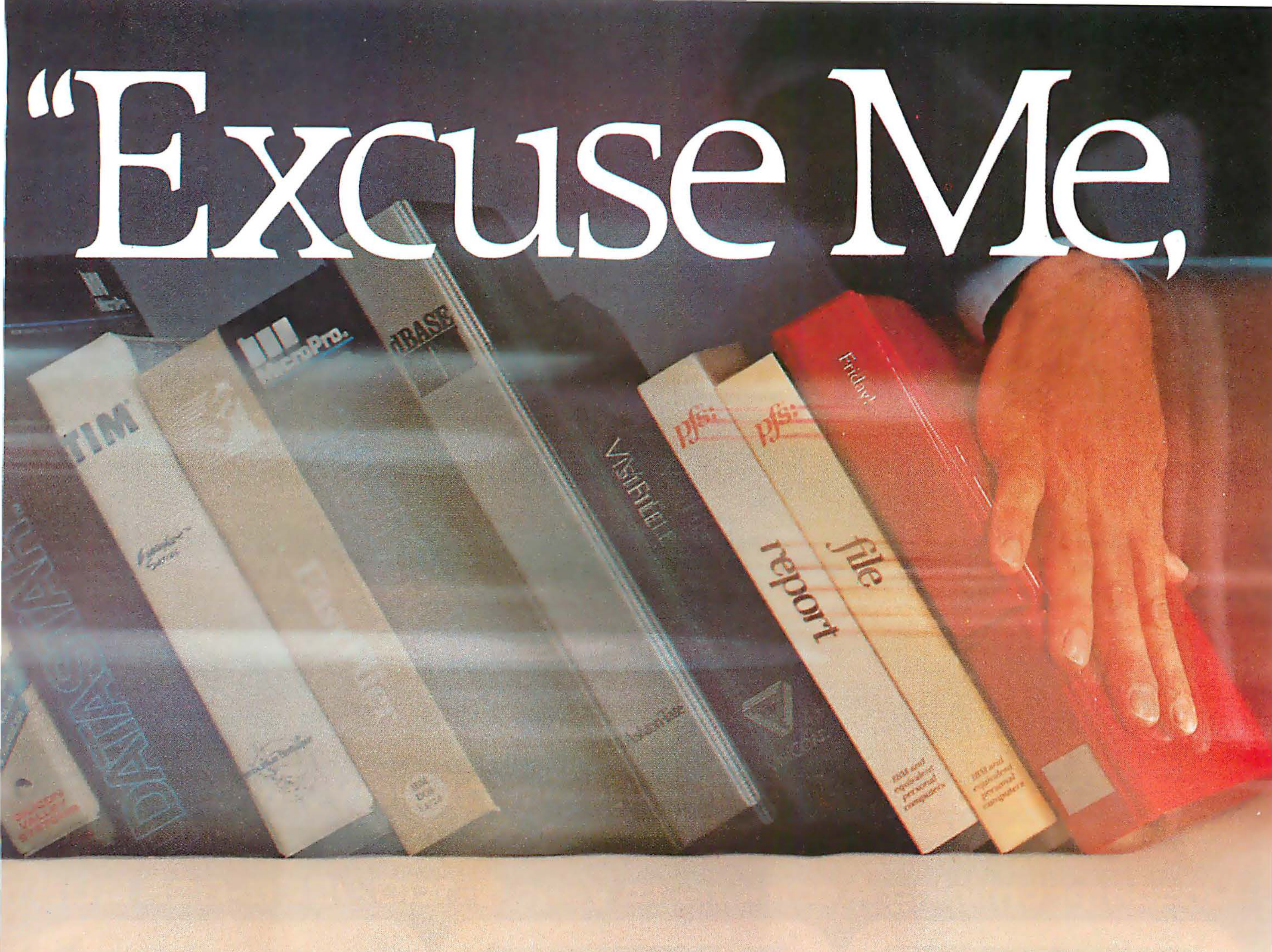
The TI-99/4A is a 16-bit computer, but the port has an 8-bit data bus, and data is multiplexed onto the bus under control of the processor, which always sends 16 bits. Since this is handled internally, almost any static-RAM board could be adapted as long as it uses 5-V chips.—Steve ■

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● TRS IDEAS GALORE
Compu-Hints Eighty is a newsletter that contains programs, hints, techniques, and reviews of material related to the TRS-80 Models I, III, and 4. A $3 fee covers postage and handling; a disk of the programs costs an additional $8. Contact Eighty Computing, 49 Sleepy Hollow Lane, Orinda, CA 94563.

● GEORGIANS MEET IN ATLANTA—The Atlanta Area Color Users Group meets at 7 p.m. at the Nash Middle School in Smyrna, Georgia, and uses a BBS at (404) 378-4410. Due to the school schedule, it only meets ten months a year. Dues have not been established. For details, contact Gary McConville, 4144 Rebel Trails, Douglasville, GA 30135, (404) 949-0369.

● TWIN STATE COMPUTERISTS MEET—For computerists in Kentucky and Indiana, a BBS is up and running at (502) 896-4419 from 6 p.m. to 9 a.m. every day. The Kentucky-Indiana Personal Computer Users Group (KIPCUG), formerly known as the Louisville or Capital Holding Users Group, maintains the BBS and offers a program library and a monthly newsletter. It meets at 7 p.m. on the first Wednesday of every month in Building #4 of General Electric's Appliance Park in Louisville. For details, contact Robert Hastings, KIPCUG, POB 3564, Louisville, KY 40201, (502) 589-0254.

● REVIEW MORROW
The *Morrow Owners' Review* is a newsletter that is mailed free to all owners of Morrow computers. Although production and mailing costs are paid by Morrow Designs Inc. of San Leandro, California, editorial control remains with the users. For details, contact Sypko Andreae, *Morrow Owners' Review*, POB 5487, Berkeley, CA 94705, (415) 654-3798.

● DELAWARE'S NORTH STAR—Details about the North Star Users Group of Delaware County can be obtained from Gil Holdsworth, POB 298, Newtown Square, PA 19073, (215) 566-2696.

● HARD COPY OF SOFT HORIZONS—For a free copy of the first issue of a newsletter for owners and users of Tandy's Model 2000, write to Soft Horizons, RD 1, Box 432, State Highway 83, Cape May Court House, NJ 08210, (609) 886-1511.

● TELECOMMUNICATIONS NEWSLETTER—Reviews of computers, modems, printers, and software relating to telecommunicating are featured in *DS/DD*, a monthly newsletter devoted to telecommunications. It is sponsored by WDI Telecommunications, a computer services company. An annual subscription is $14. For details, write to WDI Telecommunications, *DS/DD*, POB 1512, Ames, IA 50010.

● JOIN UP
An upcoming *National Directory of User Groups* welcomes information from all users groups. For a questionnaire and information, send a stamped, self-addressed envelope to Ken Ryder, POB 4102, Rome, NY 13440, (315) 339-1069.

● IBM SUPPORTS GROUPS
A bulletin board, a monthly newsletter distributed on disk, and a telephone number for general information are offered by the new IBM PC User Group Support Department in Boca Raton, Florida. Any IBM Personal Computer user group can receive support and information directly from IBM's Entry Systems Division by registering the group's officers. Contact Gene Barlow, IBM PC User Group Support (2900), POB 3022, Boca Raton, FL 33432.

● DENTAL REVIEW
An international group of dentists, physicians, and office-management people who are interested in office computers of all brands offers members a variety of services. The monthly newsletter, *Dental Computer Newsletter*, provides a forum for a software exchange, hardware and software reviews, hotline, and experienced advice for users around the world. The annual membership dues are $15; $30 overseas. For details, contact S. Nye or K. Elsbury, 1000 North Ave., Waukegan, IL 60085, (312) 223-5077.

● TEENAGE COMPUTING
A monthly magazine designed for teenage owners of Apple computers, *The Apple's Apprentice* is also suitable for readers of all ages. Topics range from fantasy to reviews, and articles comment on the use of Apples in everyday applications. A subscription is $24 a year. Contact *The Apple's Apprentice*, Emerald City Publishing Inc., POB 582-AA, Santee, CA 92071, (619) 562-7785.

● VOICES THAT CARRY
The Screaming Eagles, a users group for owners of the Eagle IIE 8-bit computer, welcomes inquiries and interaction with other users. Contact Dave Yaros, 1006 Second National Building, 830 Main St., Cincinnati, OH 45202.

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is an amateur radio license and an interest in personal computers. Meet with other amateurs every Saturday morning at 1430 Z (GMT) standard time at the frequency of 3.939 MHz. During daylight saving time the frequency is 7.232 MHz. Net control: K5DHZ Bud, or write Bud Atkinson, 6708 San Luis Obispo NE, Albuquerque, NM 87109.

● PCs IN THE OIL PATCH
The Permain PC Users Group meets at 10 a.m. on the third Saturday of the month in the Composite Technology Building of Odessa College. For information, contact the EDP Department Chairman, Odessa College, Odessa, TX 79760.

● WHAT COLOR AMERICA?
A public bulletin board system (BBS) sponsored by Color America Users Group is operating in the Los Angeles, California, area. The group is dedicated to users of the Tandy Color Computer; users of all kinds of microcomputers are welcome to participate on the BBS at (818) 334-2864. For user group information, contact Mark Randall, 2227 Canyon Rd., Arcadia, CA 91006, (818) 331-7903.

● ATARIS IN PALM BEACH
The Atari Computer Club of the Palm Beaches meets at 7:30 p.m. every second Tuesday of the month in the auditorium of the Science Museum at Dreher Park in West Palm Beach, Florida. Members can access a program/book lending library, buy software and hardware at discounts, converse with other programmers, and see demonstrations of new products. A monthly newsletter contains club news, listings of regional bulletin board services, product and software reviews, and want ads. For details, call or write Marvin Cox, 4106 Fern St., Lake Worth, FL 33461, (305) 967-8895.

● INSTRUMENTAL FOR ENGINEERS—*Personal Engineering & Instrumentation News* is a monthly newsletter for engineers and scientists who use personal computers on the job. It contains industry news, applications, a forum for exchanging tips, comments on the latest products and design techniques, and an annotated review of relevant articles in the computer media. A $25 annual subscription fee entitles you to membership in the Personal Engineering Computer Users' Society (PECUS), producer of the newsletter. For details, contact Paul Schreier, Personal Engineering Communications, Box 983, Back Bay Annex, Boston, MA 02117, (617) 536-8124.

● IRISH CLUB FOR THE 64
A nonprofit club centered in Dublin, Ireland, CLUB64 invites owners of the Commodore 64 to make use of its debugged, public-domain, program-disk library at no extra cost. News, information, product details, or programs are welcome for inclusion in a proposed disk-formatted newsletter. A charge of £5 per disk includes the cost of shipping disks within the British Isles; the international cost is higher. For details, contact Brendan Conroy, c/o Upper Drumcondra Rd., Dublin 9, Ireland.

● COMPUTER OLYMPICS
The Olympian Computer Club of Athens, Greece, represents users of all brands of computers. It is located on the Hellenikon Air Base and welcomes correspondence. Write to Paul Mullens, Olympian Computer Club, Box 4277, APO New York, NY 09223. ■

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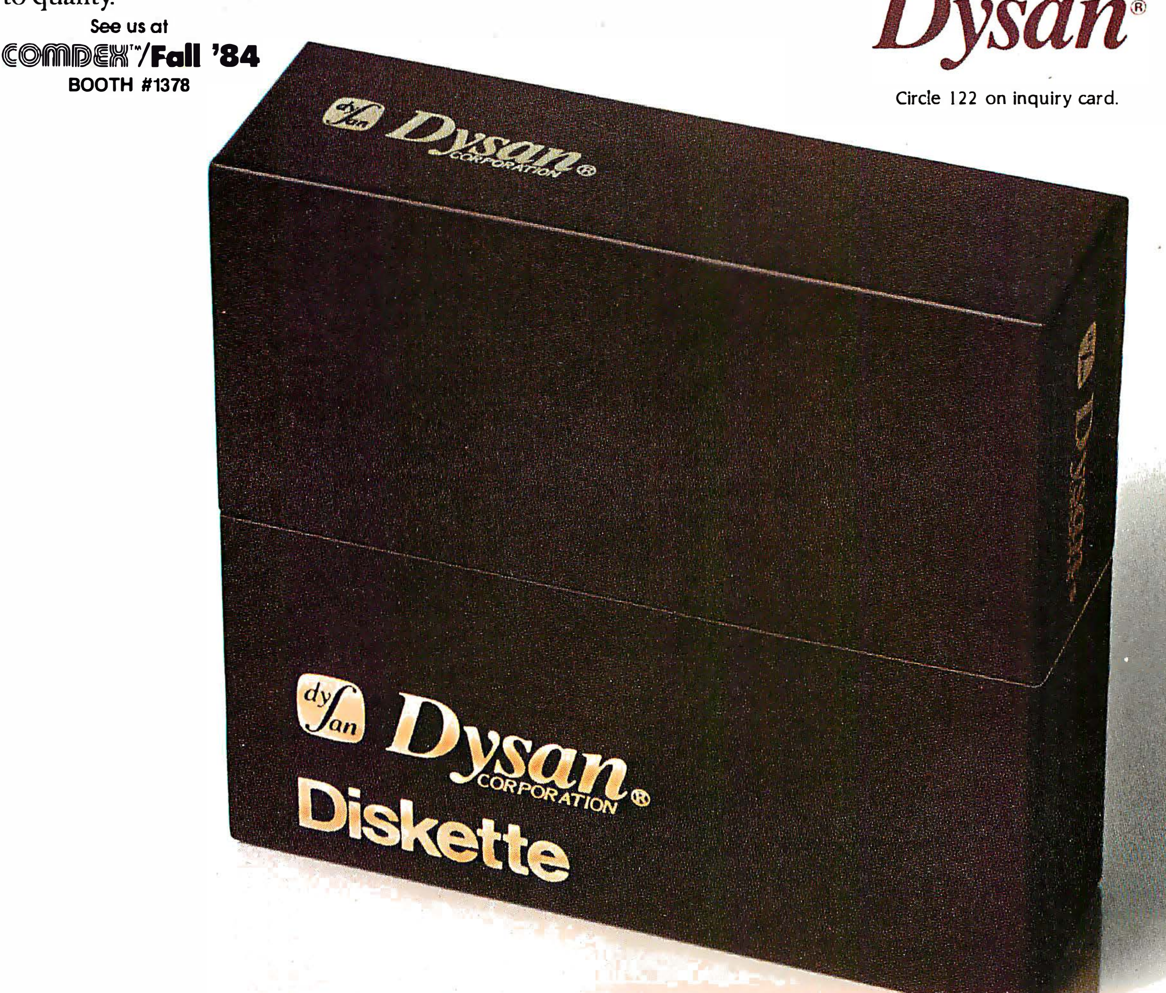
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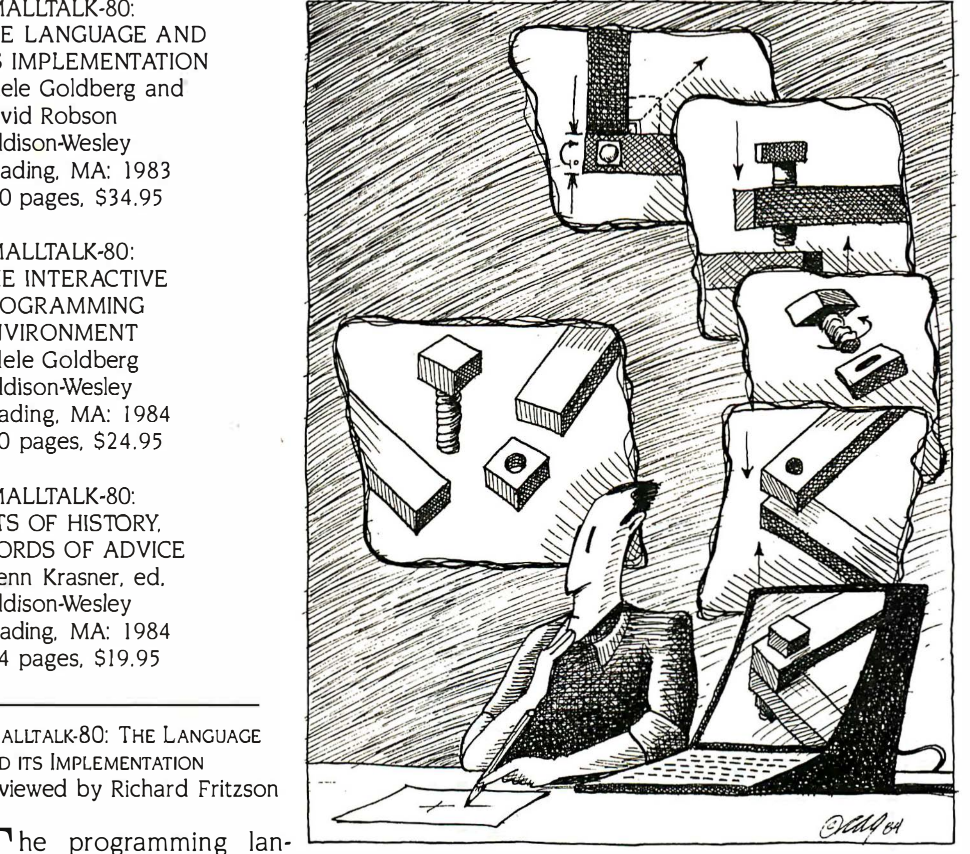
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SMALLTALK-80: THE LANGUAGE AND ITS IMPLEMENTATION
Reviewed by Richard Fritzson

The programming language Smalltalk was designed and developed during the last decade by researchers at Xerox's Palo Alto Research Center (PARC). Over a period of 10 years, without much publicity, the language went through about five repetitions of a design/implement/test cycle: programmers would design a new version of the language, implement it on one or more computers, and test it, stretching it as far as they could. Then, they would go back and redesign it. (Few programming languages, if any, have received such intensive work before being released in the marketplace.)

In 1979, Xerox PARC decided to disseminate Smalltalk to computer scientists outside of the PARC environment. A collection of articles about Smalltalk appeared in the August 1981 BYTE, and PARC's computer scientists began collaborating with four hardware manufacturers to implement Smalltalk on machines other than Xerox's in-house research computers.

In 1983, Addison-Wesley began releasing a series of books describing the Smalltalk-80 programming system (the version designed in 1980). Three of these books have been released; the fourth, *Smalltalk-80: Creating a User Interface and Graphical Applications*, is scheduled to be published this fall. The three books I review here are *Smalltalk-80: The Language and Its Implementation; Smalltalk-80: The Interactive Programming Environment*; and *Smalltalk-80: Bits of History, Words of Advice*.

The first book is a complete description of the Smalltalk computing environment and the associated language. The four hardware companies used a draft of this book as the main guide to implement the language. (It contains a complete and highly detailed description of how to implement the Smalltalk-80 programming system.) The second book describes programming in Smalltalk. While the first book accurately describes the language, the second one provides detailed descriptions of the elaborate and interactive mechanisms the Smalltalk-80 programming system provides to design, write, debug, and use programs in Smalltalk.

The third book is a collection of papers written by programmers who have implemented Smalltalk on one machine or another. This group includes not only the Xerox PARC programmers but also those from Apple, Hewlett-Packard, Tektronix, and Digital Equipment Corporation (DEC) who participated in the Smalltalk dissemination project.

Because these books come from Xerox PARC, I expect a lot from them. Because they describe a novel programming language and an exceptional programming environment at a time when people still can't sit down in front of a Smalltalk system and try things out while reading, the books must be models of clarity. The standards by which they have to be judged are higher than those for

(continued)

ILLUSTRATED BY RICHARD GOLDBERG

books on languages (such as BASIC or LISP) where the readers are expected to be using the language while they read.

The Language and Its Implementation, coauthored by Adele Goldberg and David Robson, is the backbone of this series. The book is divided into four parts. The first covers the theory behind the language and its syntax. The second is on the features provided by this implementation (a survey of the objects that are predefined in Smalltalk-80). And the last two parts provide some detailed examples of using Smalltalk in simulations and a complete description of how Smalltalk is implemented.

Smalltalk is an unusual language because it is designed to facilitate programming in an unusual environment. The Smalltalk computing world contains a collection of small computing *objects*, each of which knows how to do a few particular things by following small programs (called *methods*). The methods are internal to the objects, but all objects can send *messages* to other objects requesting that they execute one of their methods. Programming in this world consists of specifying what kinds of objects there are, which ones should send which messages, and when.

Although it sounds tricky, you need to acquire only a few new concepts. Three of them are mentioned in the preceding paragraph (objects exchange messages and execute methods when they receive them). The rest of the theory is that each object is an *instance* of a *class* (in the sense that each of us is an instance of the class of human beings) and the classes are broken into paradigms of *subclasses* (just as human beings might be considered a subclass of mammals, which are a subclass of vertebrates, which are a subclass of animals, and so on). Objects inherit their methods and internal variables from their classes (and subclasses inherit these from their superclasses). This makes it particularly easy for related objects to share code, which, in turn, makes it easier to understand and maintain programs.

The basic syntax of the language is a new adaptation of an old idea. While most languages (including Pascal or LISP) use *prefix* notation for procedure calls, and a few others (such as FORTH) use *postfix* notation, Smalltalk has, roughly speaking, adapted *infix* notation. The receiver of a message comes first, then the word that identifies the message (the selector or keyword), followed optionally by one or more parameters, with other keywords (resembling prepositions) identifying their roles in the message. For instance

```
7 + 3  ; Send 7 a message
       ; to add 3 to itself

30 sin ; Send 30 a message to
       ; compute the sine
       ; of itself

anArray at: 3 put: 30.4
  ; Send to the array variable
  ; "anArray" a message
  ; to put the value 30.4
  ; at its 3rd cell:
```

While the first example makes Smalltalk look familiar and the second makes it look like FORTH (a recurring impression), the third resembles the style of English used when instructing individuals in a group: "John, stand here. Mary, get the shovel. Steve, take this down. . . ." The expressions have a subject (the receiver), a verb (the message selector), and objects (with prepositions).

The first part of this book does an excellent job of explaining the theory of the system. The language chosen to describe the system (Smalltalk-80) is clear. The presentation is well organized; questions, both obvious and subtle, are raised and answered in turn using simple examples to illustrate. After my first reading, I

(continued)

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gained an understanding of the general style and operations of the language; and after reading all three books carefully, I found that this first part does indeed provide a good, basic understanding.

While presenting what is probably the hardest concept in the section, the idea and use of *metaclasses*, the terminology becomes obscure. Here the authors chose an unfortunate graphic technique for showing the paradigms of classes and subclasses and their associated metaclasses ("boxes in boxes" instead of the more traditional tree structure). In contrast, however, the rest of the book is highly readable.

PREDEFINED OBJECTS

The second and longest part of the book describes the objects that are built into the Smalltalk system. These form the raw materials that programmers work with. While the theory and syntax described in the first part provide a framework in which you can write large and complex, but modular, programs, it is this encyclopedia of predefined objects that makes the language both rich and powerful.

If other languages came with fifty complex data structures and hundreds of procedures and functions that operated on them, this is where they would be listed. However, it would scare most sensible programmers away. Three characteristics of Smalltalk make this part of the book readable, understandable, and assimilable.

The first is that the paradigmatic structure of the objects (the relations between general classes of objects and more specific subclasses) results in the same message name doing the same sort of thing for different kinds of objects. That is, Smalltalk is unlike some programming-language libraries where you need the procedures SIADD to add single-precision integers, DIADD to add double-precision integers, and SFADD to add single-precision floating-point numbers. In Smalltalk each object defines the message "+" to do the appropriate thing. Furthermore, the messages are categorized (in the system, not just in the presentation) into sensible groups, again with the same name used when appropriate for a variety of objects.

The second difference between this section and a more traditional presentation of data structures and operations is perhaps the most important. While Smalltalk provides traditional data structures, you don't need to use them because the predefined objects serve as *information structures*. Information structures are arrangements of data with predefined characteristics and methods of access. If you were to take a computer science course in data structures, you would learn about arrays, lists, and hash tables. The purpose of such a course is to show you how to select an appropriate data structure and write code for it to implement information structures, such as sets, bags, dictionaries, ordered collections, and so on.

In Smalltalk, sets, bags, dictionaries, sorted collections, and other information structures are predefined types of objects, complete with methods that implement their characteristics. If your program needs to associate information with keywords, instead of designing a data structure, you ask for a new instance of the object class called "Dictionary" and store your command words and their associated pieces of information in it. It is much easier to use these predefined objects than it would be to adapt a hash-table routine or a binary-search routine from a Pascal library.

If your application needs a specialized version of a standard information structure, you can inherit what you need from these built-in ones and add other methods or redefine existing ones to suit your purposes. If it turns out that the standard methods used to implement these information structures are too slow or use too much memory for your needs, you are free to reimplement them, modifying the methods provided by Smalltalk. It's all written in Smalltalk and it's all accessible. Your code or any existing system code won't need to change as long as you don't introduce errors.

(continued)

In addition to the powerful collection of information structures, this chapter also describes specific types of objects: numbers (integers, floating point, rationals), strings and characters, date and time quantities, a variety of display objects for use on the bit-mapped display screen, process schedulers (Smalltalk supports multiple processes with objects such as queues and semaphores), and others.

These sections contain pages of Smalltalk source code and associated text, providing dozens of examples on the uses of these objects. (Many Smalltalk objects implement messages that provide examples of their uses.) Two chapters in particular made me want to start trying things out: chapter 18, which is a detailed discussion of the graphics kernel of Smalltalk, and chapter 17, which provides a brief look at the system's programming interface. (Because the second book in the series is entirely about the programmer's interface, I'll reserve comments on this matter until then.)

A Big Example

The third part of the book consists of five chapters about using Smalltalk to design and implement discrete simulations. The topic here is technical; a quick look at these chapters might scare a reader off. However, for anyone who stays with it, the effect of this extended example is to clarify how programming in Smalltalk can make a complex task both manageable and understandable. As a programmer, you feel more like a director: you explain to each object how to carry out the instructions (messages) it is supposed to understand, and then you step back and direct your cast of objects to perform in a well-coordinated fashion.

A simple example, occupying only one chapter or less, wouldn't have been sufficient. Any language can look good when handling a simple example. This section also shows how Smalltalk lets you interactively develop tools for working on a class of problems, resulting in a language that easily implements simulations, instead of just a simulation program. The authors deserve recognition both for the effort involved in writing these chapters and for devoting so much space to an illustration. Readers who skip these chapters risk missing much of the point of Smalltalk.

If you read the first book, you'll know that a program is a description of a group of new object classes needed to implement a task. Each class is described by first saying what it is a subclass of (is it an array, a display form, or something completely new?) and then optionally adding local variables: the names of new messages that objects in the class understand (entry points), a description of what effect the messages are supposed to have (documentation), and the methods needed to implement these messages (the code).

However, programming in Smalltalk-80 isn't done by typing the text of the program into a text editor and then compiling it. For one thing, you'd need an encyclopedia of Smalltalk by your side in order to take advantage of the objects already in the system. For another, the researchers at Xerox PARC seem to believe that the computer should help with the programming task as much as possible.

The researchers have turned the Smalltalk system into an electronic encyclopedia with an interactive mechanism for accessing classes, objects, methods, and documentation. This interface, described briefly in Goldberg and Robson's book, is explained in detail in the second book.

Smalltalk-80: The Interactive Programming Environment

Adele Goldberg's *Smalltalk-80: The Interactive Programming Environment* is

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divided into five parts. The first is a general introduction to the Smalltalk environment. This environment is where the desktop metaphor originated. In fact, one thing that becomes clear as you read these books is that Apple's Lisa-technology software environment is directly descended from Smalltalk, not from Xerox's 8010 computer. Not only the windows, the menus, and, of course, the mouse, but the Macintosh's text- and graphics-editing programs also have precursors in Smalltalk's built-in text and graphics editors. There are small differences in style that are related to the fact that Smalltalk uses a three-button mouse while Apple uses a one-button mouse, but a Macintosh user would feel right at home. Conversely, perhaps, a Smalltalk user might feel constrained on a Macintosh because Smalltalk provides a completely integrated computing environment with text manipulation, graphics, and programming, while Macintosh provides more traditional application programs and operating system.

The next three parts of the book are ordered in the same way you would actually begin programming: how to find things in the system, how to change things, and how to correct things.

Much of a programmer's interaction with Smalltalk happens through a window called a *system browser*. This resembles a four-pane slot machine with a jackpot window in the bottom part of the screen. The window at far left displays categories of classes defined in the system. If you select one, the next window lists all of the classes in that category; if you select one of those, the next window (third one over) lists the kinds of messages this class of object can understand; and if you select one of those, the names of these messages appear in the far right-hand window. Select one of these and the large window underneath displays both the Smalltalk code that implements the message and its documentation.

You can edit the contents of the window, immediately recompile the code, and try it out. At any step along the way, you can add new categories of classes, new classes, new kinds of methods, or new methods, and the text in the window will display an appropriate skeletal form for carrying out that operation. You edit it, with a minimum of typing, and the operations are carried out.

Another type of interaction with the system is done through an *inspector*. Every object in the Smalltalk system is capable of presenting its internal state in a separate window along with a workspace in which you can test ex-

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To implement Smalltalk on a given machine, you implement the virtual machine then load the virtual image into the virtual machine.

pressions and inspect their effects on the object.

If you read this book without sitting in front of a Smalltalk machine, you will have no difficulty following the text. This is due to an abundance of large, clear illustrations of both the computer screen and the state of buttons on the mouse. The pictures, typically one-half page in size, average more than one per page. However, because the system is so much fun to use, the frustration of reading text like "Here, try this to see how it works" will probably force you to put the book down from time to time. In a field where many people say they love their work but so few books show it, these two books are pleasant exceptions to the rule.

The level of detail here goes beyond what a casual reader needs to know. You'll learn what it's like to program in a highly interactive environment where spelling checking is automatic and where interactive debugging tools appear in separate windows and disappear when not needed. It lets you edit, debug, consult, reprogram, and then pick up where your program left off, without you even being aware that you were using three or four different tools.

The book concludes with a section on linking Smalltalk with external files to facilitate the exchange of information and programs. It also contains a Smalltalk-programming appendix of "do's and don'ts" written by a member of Xerox's Special Information Systems (SIS) group. This group distributes and supports the commercial version of Smalltalk; the appendix makes it clear that there are programmers outside of Xerox who are using this language to implement complex, interactive systems. This appendix and the final section offer suggestions and practical advice.

Implementing Smalltalk

To get a Smalltalk implementation, call Xerox's SIS branch in Pasadena, California, and arrange to send them $55,000 for a Xerox 1100 SIP computer, plus $5000 for a Smalltalk license. If you can do that, you'll become the best-equipped programmer on the block. If you can't afford $60,000, you'll have to wait, but not that long.

All current Smalltalk implementations use the *virtual-machine* technique for implementing languages. First, you decide what kind of machine the language should run on, considering both the design and the run-time characteristics of the language. Then, you implement a virtual-machine emulator in software (usually in machine language or microcode). However, most of the system is written in hardware-independent Smalltalk code. This collection of Smalltalk objects is called the *virtual image.* To implement Smalltalk on a given machine, you implement the virtual machine and then simply load the Smalltalk virtual image (the objects) into the virtual machine. A well-known example of this technique for a simpler language is UCSD Pascal with its p-code interpreter serving as the virtual machine while most of the system is written in machine-independent Pascal.

All of the details of how to implement a Smalltalk virtual machine are spelled out in the last part of the first book I review here. And it's not easy: the virtual machine is a complex program. But the details are there. In fact, a complete implementation of the virtual machine is provided as an illustrative sample implementation. Individuals with experience writing large programs will look at the description and say, "Hey, I can do that." In fact, this was the purpose of this part of the book: to guide Smalltalk implementers.

However, the implementers the authors had in mind were a small group of individuals involved in a research project with Xerox. While the description of the virtual machine is very clear, there is no incentive for an

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average reader of these books to implement the machine. The reason is that while the virtual-machine description is in the public domain, the virtual image of the Smalltalk system (more than half a megabyte of Smalltalk objects) is owned and copyrighted by the Xerox Corporation and can be acquired only by hardware companies that purchase a license to incorporate the image into a hardware product.

While this is a good guide to implementing Smalltalk, and the details illustrate some of the difficulties of implementing an object-oriented language on a standard computer, it may be wasted on those who are reading the book primarily to learn about Smalltalk.

SMALLTALK-80: BITS OF HISTORY, WORDS OF ADVICE

Smalltalk-80: Bits of History, Words of Advice delivers the essential implementation details to the programmers who seek them. It is a collection of papers edited by Glenn Krasner and written by people who are reporting the results of implementing Smalltalk on some machine. The quality of the papers ranges from fair to fascinating, and the quantity of detail is great. Amusing Smalltalk cartoons drawn by Ted Kaehler and Jean Depoian add to the lightness of the book. The four sections that the papers are broken down into are "Background," "Experiences," "Measurements and Analyses," and "Future Proposals."

In the first of four "Background" papers, Adele Goldberg describes the process of releasing Smalltalk outside of Xerox. The second, written by Dan Ingalls, presents a short history of the Smalltalk language, beginning with Smalltalk-72 (which started as a 1000-line BASIC program and became an assembly-language implementation for the Nova minicomputer). One interesting nugget of information is that Smalltalk-78 was designed for, and ran on, a transportable computer with an 8086 microprocessor in a box resembling current transportable-computer designs.

Glenn Krasner describes how the world of Smalltalk objects is translated into the more traditional world of disk files for communication between machines. The final paper was written by Allen Wirfs-Brock of Tektronix (the first three authors are from Xerox PARC), and it is the starting point for implementers looking for advice from someone with experience. The writer recommends that you implement in a high-level language first, study the results, optimize, experiment, and only then go on to assembly language.

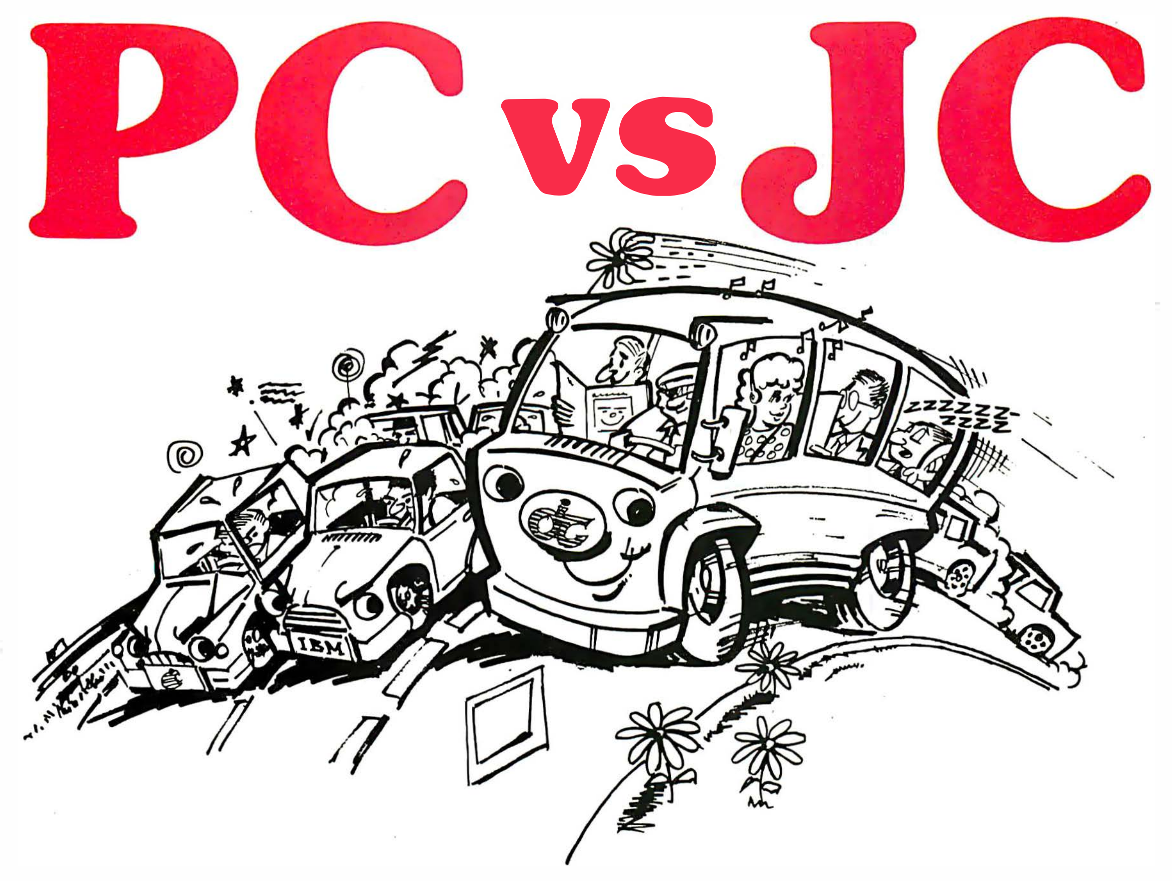
The papers in "Experiences" are detailed descriptions of problems encountered, ranging from coding errors and Pascal-compiler bugs to using implementations that required 10 minutes to clear a screen. It also contains the decisions made while implementing Smalltalk. The implementations described are for a range of computers, including the MC68000, the VAX-11/780, and Xerox PARC's Dorado (a desktop unit more powerful than the VAX). In both this and the next section, you can glimpse some well-trained professional programmers who spend a significant amount of time analyzing, studying, and criticizing the performance of their work; they know where to put the intensive effort at improving code. The details presented at this level will probably stop most people who haven't worked on a large and complex computer program.

The programmers at Tektronix, who worked with an in-house MC68000 machine, present a history of their successful attempt to implement the Smalltalk virtual machine in Pascal (cross-compiled from a DECSYSTEM 20). They include their analyses, improvements, and error logs.

At Hewlett-Packard, the implementation team also used DECSYSTEM 20 Pascal, but they actually ran the code on the system (using a graphics terminal). Later they moved it to a VAX running UNIX and translated their virtual machine into C. Their paper presents the changes they had to make to adapt the standard Small-

(continued)

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The HP team concluded that a system this flexible is vulnerable and will not make a supportable product.

talk image into an environment where 32-bit addresses are typical. As with all papers here, details are not skimped on; bugs in the virtual image, problems with floating-point arithmetic, and problems in getting the input and output routines running efficiently are mentioned, as well as a description of the multilevel debugging system used to attack development problems. Unlike the others involved, the HP team was disappointed in Smalltalk and concluded that a system this flexible is vulnerable and thus will not make a supportable product.

The paper on the Xerox Dorado implementation presents the issues that confront those who are in a position to implement all or part of their virtual machine in their processor's microcode. Here they chose to split the implementation between microcode and macrocode (conventional machine language) and described the details as they apply to the unique architecture of the Dorado computer.

The DEC group tried an initial implementation on a PDP-11/23 but later moved to a VAX-11/780; all of their details apply to the latter. Unlike most other implementations, where memory management is handled by reference counting, the DEC team adapted an incremental garbage-collection algorithm. While they prefer their technique, the body of the paper suggests they haven't reached a consensus.

The "Measurements and Analyses" section's papers are primarily tables of performance analyses. (In particular, the question repeatedly answered is: Where is the interpreter spending all of its time?) However, the first paper, by Kim McCall of Xerox, has a table of benchmarks using a collection of well-described tests that ran on 10 implementations. The paper quite rightly disclaims the significance of any comparison, both because of the disparity of the hardware involved and the varying levels of effort that had been applied to optimizing different implementations. However, there are still some interesting facts here. First, the Xerox Dorado implementation was between five and twenty times faster than its next competitor, the Xerox Dolphin (which is the Xerox 1100 SIP). The second fact is that one of the implementations, on a 10-MHz MC68000 chip, compared very favorably with Xerox's implementation on its 1100 SIP. Other papers in the book make it clear that this chip has been targeted for intensive work by many implementers. This suggests that we might soon see a Smalltalk machine with a 68000 processor for much less than $60,000.

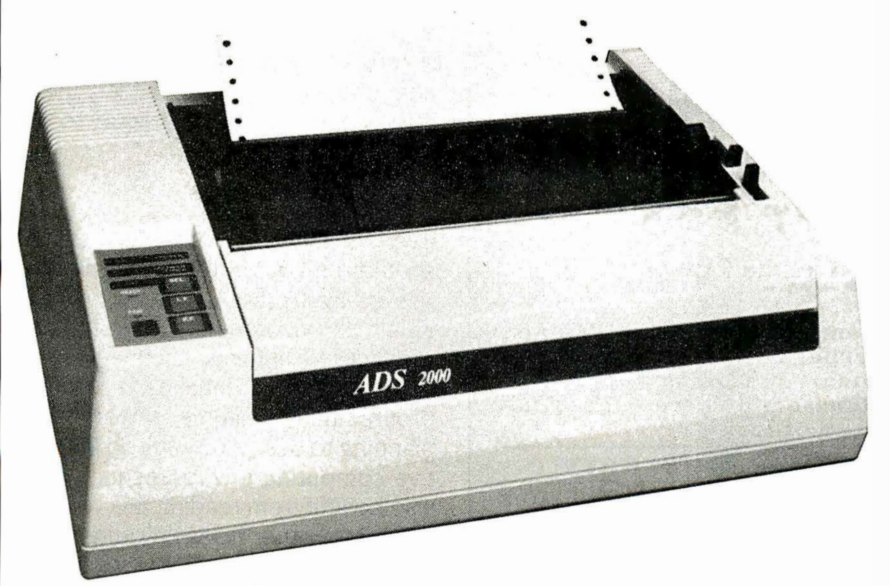
The final section of the book contains six papers discussing proposals for improving Smalltalk. Three discuss projects under development that were at the time just proposals. At Xerox, Glenn Krasner and Ted Kaehler are working on an object-oriented (as opposed to the traditional page-oriented) virtual-memory scheme, and they describe the system here. Steve Putz, also of Xerox, is in charge of managing the evolution of Smalltalk-80 systems. This is a common problem with all extensible languages; isolated implementations (installed in non-networked environments) tend to quickly evolve into incompatible dialects where improvements to one version are difficult to transfer to another. (LISP is one example.)

D. Jason Penney of Tektronix describes using Smalltalk to implement a file system. Interesting bugs and snags aside, he liked its reliability and usability, and he was using only an ex-

(continued)

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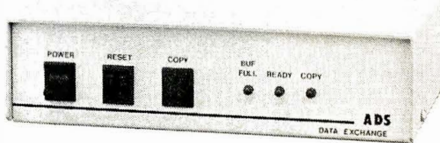
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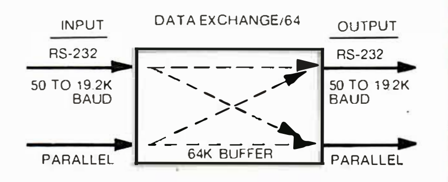
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perimental implementation.

The remaining text contains three proposals for future implementations. One sketches an implementation on the Intel 432. Another discusses general ways of speeding up the system by reducing the time necessary to find the method that implements a message. And the last is about adapting an old, but not widely used, reference-counting technique to replace the current one.

SUMMARY

Every student of computer science should read *Smalltalk-80: The Language and Its Implementation.* Whether or not Smalltalk becomes a successful and widely used language, the ideas it embodies will be essential parts of future programming systems. Anyone else planning to design or work on interactive computing environments would also benefit from reading this volume.

The two other books require more specialized interests. *The Interactive Programming Environment* is plainly a manual for Smalltalk users. While it is definitely readable without an accompanying Smalltalk system, you'll need to want to know the details of working with the Smalltalk-80 system in order to read it through. The third volume, *Bits of History, Words of Advice,* contains papers that are essential to implementers of Smalltalk, are potentially useful to implementers of complex programming systems, and might be interesting to advanced computer science students.

As a result of these three books, Smalltalk, if and when it becomes widely available, will be one of the best-documented languages around. We can only hope that when other programming languages are introduced to the computing community, they are complemented by texts of similar scope, clarity, and style. ■

[Editor's Note: A review of the last book in this Smalltalk series is forthcoming.]

Richard Fritzson (5814 Russett Rd. #4, Madison, WI 53711) is a consultant and proprietor of Computing Insights, a software company based in Madison, Wisconsin.

Trivia Quiz #1

Fill in the Blank.

It takes _______ programmers to change a database.
Cerberus was a mythical _______ with three _______ and guarded the gate of _______.

Multiple Choice.

On Howdy Doody Time the kids sat
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B. In the Peanut Gallery.
C. Jammed in the office IN basket.

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10 ea DS/DD, 40T (IBM, H/P)	$ 75	$ 32
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Micromodem IIe w/Smartcom	$ 329	$ 239
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Stack Chronograph (RS-232)	$ 249	$ 189
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Cat	$ 189	$ 139
J-Cat	$ 149	$ 104
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Quadmodem, Internal IBM NEW!	$ 595	$ 425
Quadmodem, tand alone NEW!	$ 695	$ 495

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★ 13" Color I+, Composite	$ 399	$ 249
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★ 13", Color IV, RGB, 720Hx400V, (IBM)	$ 795	$ 685
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★ Amber, MAX-12 (for Mono Board)	$ 249	$ 199
★ QUADRAM, Quadchrome 12" RGB Color	$ 695	$ 495
Quadscreen 17" 968x512	$1995	$1595
★ Quadchrome II, 14" RGB Color NEW	$ 650	$ 450
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RX80, F/T	$ 499	Call
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FX100, 160 cps	$ 895	Call
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Microfazer, w/Copy, PP, 8K, #MP8 w/PS	$ 179	$ 139
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Microfazer, w/Copy, PP, 128K, w/PS	$ 375	$ 345
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I/O Plus II, 2S/P/CC/G		$ 315	$ 215
MonoGraphPlus™ P/CC (for Lotus)		$ 495	$ 375
PCNet, Starter Kit, PC002			$1095
PCNet, Circuit Board, PC001			$495
*CCS SuperVision, 132 col., mono. board		$ 799	$399
Graphics Adapter for Supervision		$ 250	$ 99
Chalkboard, Power Pad (Requires Kit)		$ 100	$ 73
Chalkboard Starter Kit		$ 50	$ 34
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Quadboard 256K, expand to 384K, S/P/CC		$ 675	$ 525
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Quadboard II, 64K, expand to 256K, 2S/CC		$ 395	$ 265
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Quad 3278	NEW	$1195	Call
Quadnet VI	NEW		Call
Quadnet IX	NEW		Call
Tecmar Graphics Master		$ 695	$ 545
1st MATE, 64K, S/P/CC		$ 389	$ 275
1st MATE, 256K, S/P/CC		$ 589	$ 399
Captain, 64K, S/P/CC		$ 424	$ 324
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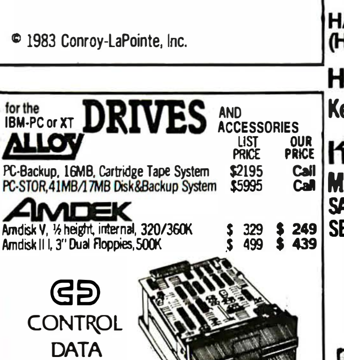
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October 1984

● MEDICAL COMPUTER SEMINAR—Medical Computer Weekends, various sites throughout the U.S. For cardiologists, internists, and primary-care physicians. Focuses on the role of the multipurpose medical office computer. Seminars qualify for 13 hours CME Category 1 credit. Contact International Medical Education Corp., 64 Inverness Dr. E, Englewood, CO 80112, (800) 525-8651; in Colorado, (303) 790-8445. *October*

● SEMINARS FOR PROFESSIONALS—Professional Development Seminars, various sites throughout the U.S. Topic areas: data communications, database management, EDP operations, microcomputers, software engineering, CAD/CAM, IBM mainframes, office automation, and others. Fees range from $195 to $1095. Contact Institute for Advanced Technology, 6003 Executive Blvd., Rockville, MD 20852, (800) 638-6590; in Maryland, (301) 468-8576. *October*

● COURSES FROM ICS Courses from Integrated Computer Systems, various sites throughout the U.S. Among the courses offered are "Computer Network Design and Protocols" and "Data Communications." Fees are generally $895. For more information, contact Integrated Computer Systems, 6305 Arizona Place, POB 45405, Los Angeles, CA 90045, (800) 421-8166; in California, (800) 352-8251 or (213) 417-8888. *October–November*

● SHOWS IN GERMANY *Chip* Microcomputer Weeks, various sites throughout West Germany. Microcomputer products, trends, and applications will be demonstrated. Sponsored by *Chip*, a leading German computer magazine. Contact Network GmbH, An der Friedenseiche 10, D-3050 Wunstorf 2, Bundesrepublik Deutschland (West Germany); tel: (0 50 33) 10 56; Telex: 92 45 45. In England, Network Events Ltd., Printers Mews, Market Hill, Buckingham MK18 1JX, England; tel: (02 80) 81 52 26; Telex: 83111. *October–November*

● BRUSH-UPS FOR ENGINEERS—Continuing Engineering Education Courses, George Washington University, Washington, DC. Among the course titles are "Microcomputer Application Workshop: Evaluating Microcomputer Software Packages" and "Workshop in Data Communications for Microcomputers." Tuition ranges from $625 to $875. Contact George Harrison, Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-6106. *October–December*

● COMPUTER SHOWCASES Computer Showcase Expo, various sites throughout the U.S. These traveling shows feature regional and national vendors of computer systems, peripherals, software, and accessories. Admission is $7.50 or $5, depending on location. Discount tickets are available from participating exhibitors. For a schedule, contact The Interface Group Inc., 300 First Ave., Needham, MA 02194, (800) 325-3330; in Massachusetts, (617) 449-6600. *October–December*

● INDUSTRIAL ENGINEER PROGRAMS—1984 Institute of Industrial Engineers' Continuing Education Programs, various sites throughout the U.S. Among the programs on the agenda are "Robotics—Equipment, Applications, and Methodology" and "Effective Utilization of Microcomputers." A complete listing is available from the Institute of Industrial Engineers, 25 Technology Park/Atlanta, Norcross, GA 30092, (404) 449-0460. *October–December*

● INFORMATION-PROCESSING SEMINARS New York University Seminars in Information Processing, various sites throughout the U.S. "Fundamentals of Data Processing for Administrative Assistants and Secretaries" and "Managing Systems Projects" are two of the seminars offered. For a calendar listing and more information, contact School of Continuing Education, Seminar Center, New York University, 575 Madison Ave., New York, NY 10022, (212) 748-5094. *October–December*

● INTEL WORKSHOPS Microcomputer Workshops, various sites throughout the U.S. and Canada. Intel, the semiconductor memory manufacturer, is offering more than 20 workshops on microprocessor applications. A brochure is available. Contact Customer Training, Intel Corp., 27 Industrial Ave., Chelmsford, MA 01824-3688, (617) 256-1374. *October–December*

● LECTURE SERIES Montclair State College Colloquium Lecture Series and the Nobel Laureate Lecture Series, Richardson Hall, Room W-117, Upper Montclair, NJ. Topics to be addressed include "The Birth and Prospects of Expert Systems" and "Industrial Applications of Input/Output Analysis." Admission is free. Contact Professor Gideon Nettler, Department of Mathematics and Computer Science, Montclair State College, Upper Montclair, NJ 07043, (201) 893-4294. *October–December*

● PROFESSIONAL EDUCATION—Seminars from the Institute for Professional Education, various sites in the U.S. Programs in statistics, management, simulation and modeling, personal computers, and computer science. Contact the Institute for Professional Education, POB 756, Arlington, VA 22216, (703) 527-8700. *October–December*

● SHOWS IN FLORIDA The Great Southern Computer Show, various sites throughout Florida. Computer hardware, software,

(continued)

IF YOU WANT *your organization's public activities listed in BYTE's* Event Queue, *we need to know about them at least four months in advance. Send information about computer conferences, seminars, workshops, and courses to BYTE,* Event Queue, POB 372, *Hancock,* NH 03449.

peripherals, accessories, and word- and data-processing equipment will be featured. Schedules are available from Great Southern Computer Shows, POB 655, Jacksonville, FL 32201, (904) 356-1044.
October–December

● MIDWEST ELECTRONICS
The Mid-America Electronics Convention, MAECON/84, St. Louis, MO. Exhibits, seminars, tutorials, and symposia. Contact Electronic Representatives Association, 20 East Huron St., Chicago, IL 60611, (312) 649-1333.
October 10–11

● NETWORK ARCHITECTURES—Introduction to Network Architectures, Atlanta, GA. This course provides an introduction to network architectures and prepares participants to pursue the study of specific network components applicable to their needs. The fee is $795. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547.
October 10–12

● NETWORKS EXPLORED
Localnet '84, Sheraton Harbor Island Hotel, San Diego, CA. Speakers, papers, and exhibitions will look at local network technology and the effects of office automation. Contact Online Conferences Inc., Suite 1190, 2 Penn Plaza, New York, NY 10121, (212) 279-8890.
October 10–12

● PROJECT MANAGEMENT SEMINAR—Software for Project Management and Estimating, Washington, DC. Fee: $425. Contact CIP Information Services Inc., 1105-F Spring St., Silver Spring, MD 20910, (301) 589-7933.
October 11–12

● GOLDEN STATE EXPO
Computer Expo and PC Faire, Cal Expo, Sacramento, CA. Contact Computer Expo & PC Show, Suite 395, 2020 Hurley Way, Sacramento, CA 95825, (916) 924-9351.
October 11–14

● EDUCATIONAL COMPUTER FAIR—Fourth Annual Educational Computer Fair, Cleveland, OH. Contact Educational Computer Consortium of Ohio, 4777 Farnhurst Rd., Cleveland, OH 44124, (216) 291-5225.
October 12–13

● LONE STAR COMPUTING
The Second Annual Heart of Texas Computer Show, Convention Center, San Antonio, TX. Exhibits of computers, games, robots, and other high-tech products. Contact Heart of Texas Computer Show, POB 12094, San Antonio, TX 78212, (512) 681-2248. *October* 12–14

● COMPUTERS IN LAB
Laboratory Computer Interfacing, McGill University, Montreal, Quebec, Canada. Two short courses, "Computers in the Laboratory" and "Laboratory Computer Interfacing," are offered. Contact Dr. Eric Salin, Department of Chemistry, McGill University, Montreal, Quebec H3A 2K6, Canada, (514) 392-5784.
October 13–14

● TENTH VIDEO SHOW
VIDCOM, Cannes, France. The tenth anniversary of this meeting of video-communications professionals. Contact Commissariat Général, 179, Avenue Victor-Hugo, 75116 Paris, France; tel: (33) (1) 505.14.03; Telex: 630.547 MIDORG. *October* 13–17

● FUTURE OF VIDEODISC
The Second International Conference on the Future of Optical Memories, Videodiscs, and Compact Disks to the Year 2000, Loew's Sum-

mit Hotel, New York City. Speakers and demonstrations. The fee is $795. Contact Technology Opportunity Conference, POB 14817, San Francisco, CA 94114-0817, (415) 626-1133.
October 15–17

● HIGH-TECH TUTORIAL
Tutorial Short Course from Hellman Associates, Boston, MA. Topic: "Error Correction." The fee is $895. Contact Hellman Associates Inc., Suite 300, 299 California Ave., Palo Alto, CA 94306, (415) 328-4091.
October 15–17

● UNIX INSIDE AND OUT
UNIX Operating System Exposition and Conference, Sheraton Centre Hotel and Marina Exposition Complex, New York City. Seminars, social functions, and 350 exhibition booths. Contact National Expositions Co. Inc., 14 West 40th St., New York, NY 10018, (212) 391-9111.
October 16–18

● WEST COAST EXPO, CONFERENCE—The West Coast Electronic Office Expo and Conference, EOE '84, Convention Center, San Jose, CA. More than 200 exhibits. Contact Cartlidge & Associates Inc., Suite 205, 4030 Moorpark Ave., San Jose, CA 95117, (408) 554-6644.
October 16–18

● OFFICE COMPUTERS
The Sixth Annual Calgary Computer and Office Automation Show, Roundup Centre, Calgary, Alberta, Canada. Contact Industrial Trade Shows, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, Canada, (416) 252-7791.
October 17–18

● COMPUTERS, COMMAND, CONTROL—The Second Annual Symposium and Exhibition of AFCEA, Inn at Executive Park, Kansas City, MO. The theme for this year's symposium is "The Role of Knowledge-Based Systems in Command and Control." Panel discussions, paper presentations, and exhibits. Contact Armed Forces Communications and Electronics Association, POB 456, Leavenworth, KS 66048, (913) 651-7800.
October 17–19

● ASIS MEETING
The Forty-Seventh Annual Meeting of American Society for Information Science, Franklin Plaza, Philadelphia, PA. This year's theme is "1984—Challenges to an Information Society." Contact 1984 ASIS Convention, The Automated Office, 3401 Market St., Philadelphia, PA 19104. *October* 21–26

● HUMAN FACTORS
The 1984 Annual Meeting of The Human Factors Society, Hyatt Regency Hotel, San Antonio, TX. Panel discussions, workshops, and research reports will focus on the theme "New Frontiers for Science and Technology." Contact Patrick Dowd, USAF School of Aerospace Medicine, USAF-SAM/VN, Brooks AFB, TX 78235, (512) 536-3464.
October 21–26

● ISMM SYMPOSIUM
The Twenty-Sixth International Society for Mini and Microcomputers International Symposium, Statler Hotel, New York City. This symposium covers all areas of engineering, signal processing, communication, robotics, networks, education, and graphics. Contact Canadian Secretariat (ISMM), POB 25, Station G, Calgary, Alberta T3A 2G1, Canada, (403) 286-1589.
October 22–24

● SOFTWARE USERS MEET
Annual Meetings of the Oxford Software International User Group, Hyatt Regency, Crystal City, Washington, DC.
(continued)

Think about it a moment.

If you were to sit down and design your own integrated PC software system, what would you aim for?

Wouldn't you want to be able to integrate information from all modules in one window right on the screen? And then print it?

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Wouldn't you design each module to have its own appropriate file structure?

Beyond the brass ring.

Naturally, you'd also want it to run on a standard 256K PC.

It goes without saying that you'd want compatibility with the leading single-purpose programs.

And if you were to dream a bit, you'd go for concurrency because it would be great to do two or three jobs at the same time.

If you'd do all that in designing your own integrated program you'd certainly expect companies like Lotus and Ashton-Tate to do the same.

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Enable can integrate data from all modules in one window and then print or transmit it. For instance, you can create graphs from a spreadsheet *or* database. Then insert the graphs, the spreadsheet and DBMS data between text in a single word processing document *right on the screen.*

Functionality? Just as *you'd* do it, Enable's word processing, spreadsheet, database management, graphics and telecommunications are, without exception, equal to the leading stand alone business programs.

Further, Enable's files are not forced into clumsy or unsuitable structures. Enable isn't spreadsheet-based *or* document-based *or* DBMS based. Each module is designed for a specific application.

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Your eyes blinked at our mention of 256K. Yet that's all you need to operate a spreadsheet with 136K of workspace. Or a word processing document whose size is limited only by available disc space. Or a DBMS file with up to 130,000,000 bytes of data.

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And you can work on your spreadsheet while you're printing a monthly report and receiving stock quotes over the wire—all at the same time.

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Borrow a loaner copy from one of our dealers and give it a workout on your own.

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Integrated software shouldn't be a matter of choosing which compromises to live with.



For the IBM®-PC and selected compatibles.

Commodore Grace Hopper will deliver the keynote address. Contact Oxford Software International User Group, 174 Boulevard, Hasbrouck Heights, NJ 07604, (201) 288-1515. *October* 22–24

● HOOSIER COMPUTERFEST—Indy/Con '84, Indiana Convention Center and Hoosier Dome, Indianapolis. The largest microcomputer/electronics exhibition and conference in the state. Contact Indy/Con, 5160 East 65th St., Indianapolis, IN 46220, (317) 842-3024. *October* 23–24

● INTERNATIONAL CONFERENCE IN FRANCE
The Sixth International Conference—IDATE, Montpellier, France. A forum for the exchange of information and experiences. Contact Bureaux du Polygone, Rue des Etats du Languedoc, 34000 Montpellier, France; tel: (67) 65.48.48; Telex: IDATE 490290. *October* 24–26

● COMPUTERS IN CONSTRUCTION—Computers in Construction, Atlanta, GA. Fee: $425. For further details, contact CIP Information Services Inc., 1105-F Spring St., Silver Spring, MD 20910, (301) 589-7933. *October* 25–26

● COMPUTERS AND SOFTWARE—The Third Annual Twin Cities Computer Show and Software Exposition, Minneapolis Auditorium, Minneapolis, MN. Contact CompuShows, POB 3315, Annapolis, MD 21403, (800) 368-2066; in Annapolis, (301) 263-8044; in Baltimore, (301) 269-7694; in the District of Columbia, (202) 261-1047 *October* 25–28

● COMPUTERS IN ARTS
Symposium on Small Computers in the Arts, University Hilton Hotel, Philadelphia, PA. Introductory and advanced courses in computer animation, music, graphics, interfaces, and legal issues complemented by talks, exhibits, research presentations, a computer art gallery, and film shows. Contact Symposium, POB 1954, Philadelphia, PA 19105. *October* 25–28

● PC FAIRE
The Second Annual PC Faire, San Francisco, CA. Exhibits, speakers, seminars, and workshops. Contact Computer Faire Inc., 570 Price Ave., Redwood City, CA 94063, (415) 364-4294. *October* 26–28

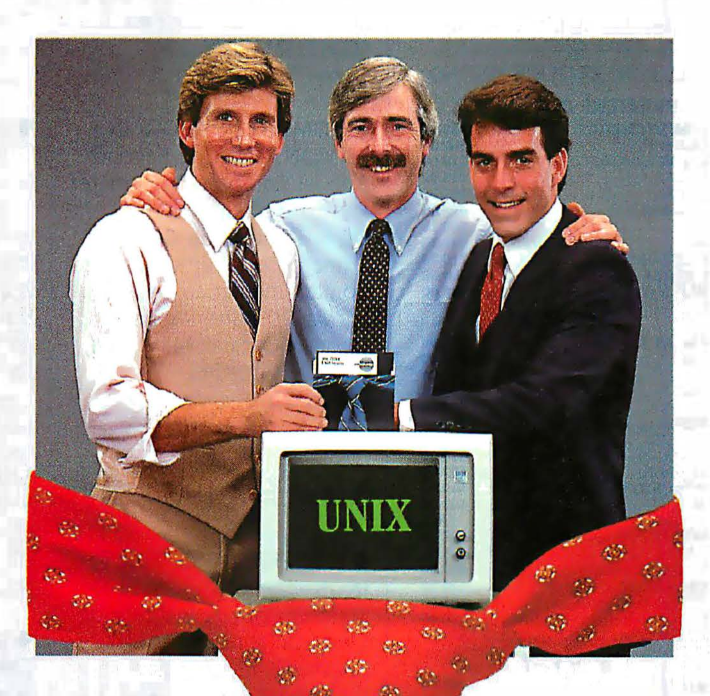
● ENGINEERS MEET IN NC
The 1984 North Carolina IEEE Symposium and Exhibition, Adam's Mark Hotel, Charlotte, NC. Seminars and a keynote session on "Personal Computers and Workstations: Applications for All Professionals" will be featured. Contact Gene Rohrer, 65C, 202-3, IBM Corp., 1001 W. T. Harris Blvd., Charlotte, NC 28257. *October* 29–30

● FINANCIAL COMPUTING
MicroScape-84: Profits at Your Fingertips, Amfac Hotel and Resort, Dallas/Fort Worth Airport, TX. A conference and exposition for financial institutions. Hands-on workshops and evening labs using Apple, Compaq, and Wang computers. Contact Joanne Wise, Banking Administration Institute, 60 Gould Center, Rolling Meadows, IL 60008, (312) 228-6200. *October* 30–*November* 2

● PROGRAM FOR PROFESSIONALS—Wescon/84 and Mini/Micro West-84, Anaheim, CA. Topics include artificial intelligence, computer peripherals, graphics, speech recognition/synthesis, and telecommunications.

(continued)

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Contact Electronic Conventions Management, 8110 Airport Blvd., Los Angeles, CA 90045, (213) 772-2965.
October 30–November 2

● COMPUTER SHOW IN EDMONTON—The Second Annual Edmonton Computer and Office Automation Show, Convention Centre, Edmonton, Alberta, Canada. Contact Industrial Trade Shows, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, Canada, (416) 252-7791.
October 31–November 2

November 1984

● CONFERENCES, MEETINGS—Conferences and Meetings of the Institute of Electrical and Electronics Engineers, various sites throughout the U.S. and the world. A calendar of conferences and meetings complete with contact persons is available. Contact IEEE Computer Society, POB 639, Silver Spring, MD 20901, (301) 589-8142.
November–January 1985

● EDUCATIONAL CONFERENCE—The Fourth Annual Educational Computing Conference, Plymouth State College, Plymouth, NH. Six simultaneous sessions will explore the conference themes "Practical Applications in the Classroom" and "Computer Literacy for Students and Teachers." Contact Ms. Peggie Riley, Department of Computer Science, Plymouth State College, Plymouth, NH 03264, (603) 536-1550, ext. 533.
November 3

● COMPUTERS FOR SALE The Computer Supermarket, Santa Clara County Fairgrounds, San Jose, CA. Retailers, manufacturers, and distributors will display and sell hardware and software for the home, business, and school. Admission is $6. Contact Microshows, POB 4323, Foster City, CA 94404, (415) 340-9113.
November 3–4

● SOUTHWESTERN FAIR The Third Annual Tucson Computer Fair, Park Mall, Tucson, AZ. This fair, run entirely by students of the Management Information Systems Department at the University of Arizona, features hardware and software for business, home, personal, and entertainment use. Admission is free. Contact Tucson Computer Fair, Management Information Systems Association, S.U.P.O. Box 20826, Tucson, AZ 85720, (602) 621-4615.
November 3–4

● MEDICAL COMPUTING The Eighth Annual Symposium on Computer Applications in Medical Care, SCAMC, Washington Hilton Hotel, Washington, DC. A varied program covering new, controversial, and state-of-the-art topics on computers and health care. Contact Gail Mutnik, SCAMC Symposium Coordinator, Office of Continuing Medical Education, George Washington University Medical Center, 2300 K St. NW, Washington, DC 20037, (202) 676-8928.
November 4–7

● GRAPHICS COURSE Introduction to the Graphics Kernel System (GKS), Hyatt Regency Hotel, Austin, TX. In addition to its specific technical features, the history and the relationship of GKS to other standards will be covered. Tuition is $495. Contact Nova Graphics International Corp., 1015 Bee Cave Woods, Austin, TX 78746, (512) 327-9300.
November 5–6

● SHOW IN BEIJING China Comm 84, Beijing Ex-

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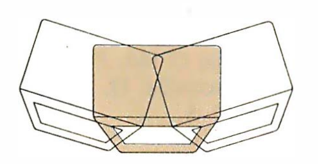
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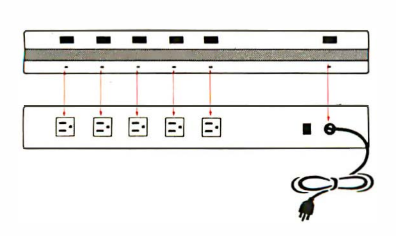
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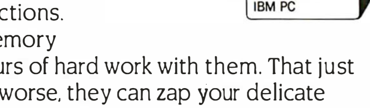


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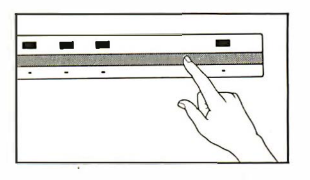
Stop fumbling with cords and scrambling for outlets to plug in your peripherals. Stop lunging to the other side of the room just to turn on your printer. The Master Piece functions as a five outlet power strip to organize all your power needs. Power up with the master switch, then use the individual switches to control your peripherals. Touch the master switch to shut down and the Master Piece makes sure you never accidentally leave your peripherals running overnight.

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During the course of an active day, you build up static electricity—just as much a threat as surges and spikes. Until now, the only solutions to static were unsightly floor mats or pads that fit under your computer. The Master Piece offers an elegant alternative. Just touch its nameplate before you begin work and all static charges are safely grounded.

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hibition Center, Peoples Republic of China. This exposition includes telecommunications, electronics, and computer exhibits. Contact Clapp & Poliak International, POB 70007, Washington, DC 20088, (301) 657-3090. *November 5–13*

● ERGONOMICS CONFERENCE—The First International Symposium of Ergonomics, Industrial Design, and Manufacturing: Ergodesign '84, Conference and Exhibition Centre, Montreux, Switzerland. A noncommercial exhibit will present equipment and materials that meet ergonomic and aesthetic needs. Contact Ergodesign '84, Conference and Exhibition Centre, POB 97, CH-1820, Montreux, Switzerland; tel: (021) 630440; Telex: 453 222. *November 6–9*

● DPMA SHOW IN FLORIDA—The Fifth Annual Vendor and Trade Show, Sheraton Inn, Jacksonville, FL. Sponsored by the Jacksonville chapter of the Data Processing Management Association. Contact Jacksonville DPMA, POB 272, Jacksonville, FL 32201. *November 7–8*

● COMPUTERS IN NUTMEG STATE—The Computer and Electronics Show, Civic Center, Hartford, CT. More than 160 manufacturers will display a variety of electronic gadgetry, including hardware, software, peripherals, and communications equipment. Contact Daniels Productions Inc., 211 Park Rd., West Hartford, CT 06119, (203) 233-9611. *November 8–10*

● MOTION CONTROL SEMINAR—Seminar from the Electronic Motion Control Association, San Jose, CA. Contact EMCA, Suite 1200, 230 North Michigan Ave., Chicago, IL 60601, (312) 372-9800. *November 12–13*

● X.25, PACKET NETS X.25 and Packet-Switching Networks, Atlanta, GA. This course will cover the internal operations of the packet-switching network and its implementation. International standards and X.25 interfaces will be discussed. Tuition is $795. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. *November 14–16*

● WESTERN EDUCATORS MEET—The Eighth Annual Western Educational Computing Conference, Vacation Village, San Diego, CA. Refereed papers on computer science, humanities and the fine arts, CAI, administration, and research support. Contact Dr. Virginia S. Lashley, Glendale College, 1500 North Verdugo Rd., Glendale, CA 91208. *November 15–16*

● FORTH CONVENTION The Sixth Annual FORTH Convention and Banquet, Hyatt Palo Alto, Palo Alto, CA. Contact FORTH Interest Group, POB 1105, San Carlos, CA 94070, (415) 962-8653. *November 16–17*

● IBERIAN COMPUTING SIMO '84—The XXIV International Show of Business Equipment and Data Processing, IFEMA Fair Grounds, Casa de Campo, Madrid, Spain. A conference and exhibition. Contact Feria de Muestras Monográfica Internacional del Equipo de Oficina y de la Informática, Plaza de Alonso Ma tinez, 3, Madrid 4, Spain; tel: 448 47 94; Telex: 27307 CLAVE 514. *November 16–25*

(continued)

Photo is of the actual printer rescued from Robert Brannon's fire.

WHAT A RAGING FIRE TAUGHT US ABOUT RELIABLE PERSONAL PRINTERS.

That's a printer? We've always known that Okidata makes the toughest printers, but Robert Brannon really proved it. A fire left his Microline 92 looking more like a pile of charred Silly Putty® than a printer, but being an optimist, Mr. Brannon took it to his Okidata dealer to see if anything could be salvaged.

The service department at Wolff Computers in New York City wasn't quite as optimistic, especially when they saw that the heat of the blaze had actually melted the casing and molded the plastic onto the internal workings of the printer.

But willing to try anything once, they plugged the unit into one of their computers, snapped on the print mode, tapped the printhead lightly, and Robert Brannon's smokey, burned, half-melted Okidata did just what it had always done . . . it printed. It printed fast and it printed beautifully.

Red-hot performance. We're not surprised. The durability of Okidata printers has become downright legendary. With a printhead that lasts well beyond 200,000,000 characters and a warranty claim rate of less than 1/2 of 1%.

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● FARM COMPUTER CONFERENCE—The 1984 Purdue On-Farm Computer Use Conference and Trade Show, Purdue University, West Lafayette, IN. Workshops will complement exhibits and conference sessions. Contact Continuing Education Business Office, Stewart Center, Room 110, Purdue University, West Lafayette, IN 47907. *November 18–20*

● CANADIAN CONFERENCE—Annual CIPS Computer Conference, International Centre, Toronto, Ontario, Canada. Speakers will address a variety of issues. Contact Canadian Information Processing Society, Fifth Floor, 243 College St., Toronto, Ontario M5T 2Y1, Canada, (416) 593-4040. *November 19–22*

● COMPUTERS IN TORONTO—The Fifteenth Annual Canadian Computer Show and Conference, International Centre, Toronto, Ontario, Canada. Contact Industrial Trade Shows, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, Canada, (416) 252-7791. *November 19–22*

● SHANGHAI EXPOSITION The China International Microelectronics/Computer Exhibition and Conference, Shanghai, Peoples Republic of China. Integrated circuits, semiconductors, personal computers, minicomputers, peripherals, and software will be exhibited. Contact American Exhibition Services International Inc., POB 66373, O'Hare International Airport, Chicago, IL 60666, (312) 593-2462. *November 21–26*

● TRADE SHOW IN MOSCOW—Systemotronica '84, Sokolniki Exhibition Centre, Moscow, Union of Soviet Socialist Republics. An international trade exhibition of office systems, electronics, and components. Contact Düsseldorfer Messegesellschaft mbH-NOWEA, POB 32 02 03, D-4000 Düsseldorf 30, Federal Republic of Germany; tel: (0211) 45 60-729; Telex: 8 584 853 mes d. *November 22–30*

● CANADIAN ATLANTIC SHOW—Moncton Computer Exhibition '84, Moncton, New Brunswick, Canada. Home computers, video games, and office automation equipment will be displayed. Contact Anne LeBlanc, Commerce Building, University of Moncton, Moncton, New Brunswick E1A 3E9, Canada, (506) 858-4555. *November 23–25*

● COMPUTERS IN CHINA Computer China, Xiamen Special Economic Zone, Peoples Republic of China. Contact Kallman Associates, 5 Maple Court, Ridgewood, NJ 07450, (201) 652-7070. *November 25–December 1*

● ENGINEERING INSTITUTE—The Twenty-Second Annual Reliability Engineering and Management Institute, Tucson, AZ. Contact Dr. Dimitri Kececioglu, Aerospace and Mechanical Engineering, Building 16, Room 200-B, University of Arizona, Tucson, AZ 85721, (602) 621-6120. *November 26–30*

● ROBOTICS IN WEST Robots-West, Anaheim Convention Center, Anaheim, CA. Robot manufacturers and component suppliers will exhibit their wares. Contact Robot Institute of America, POB 1366, Dearborn, MI 48121, (313) 271-0778. *November 27–29*

● LOCAL NETWORK COURSE—Local Area Networks, Atlanta, GA. This course looks at the alternative technical approaches

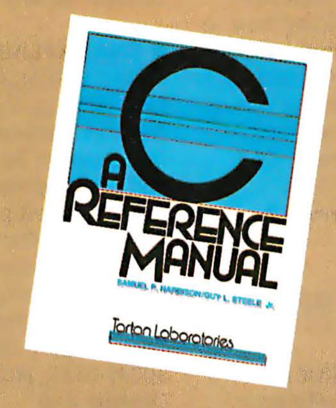
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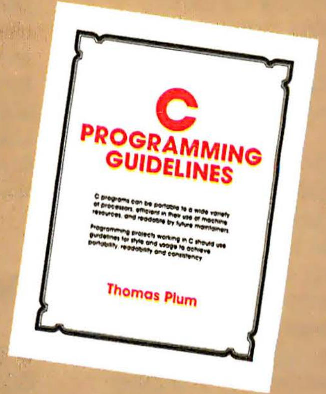
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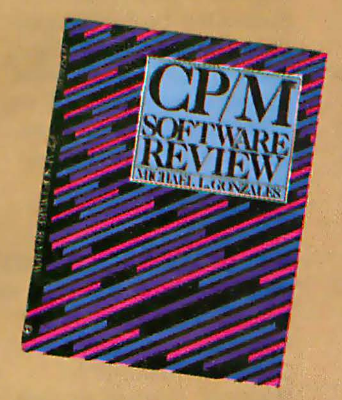
Application Development without Programmers by James Martin. $40.00(cl)



C: A Reference Manual by Tartan Laboratories, Inc. $19.95(pa)



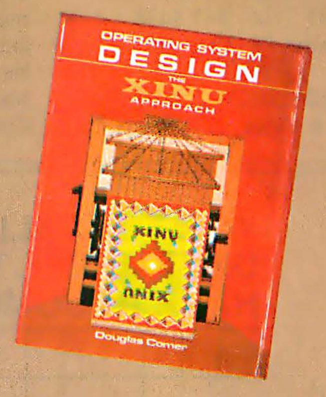
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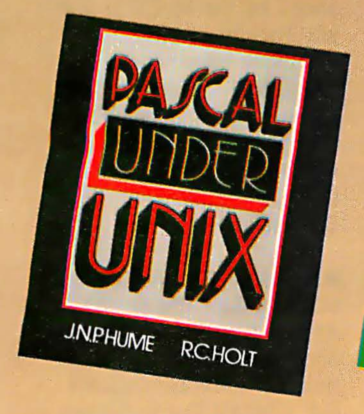
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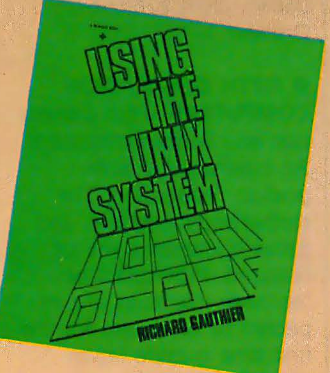
Microcomputer Systems: The 8086/8088 Family, Architecture, Programming, and Design by Yu-Cheng Liu & Glenn Gibson. $36.95(cl)



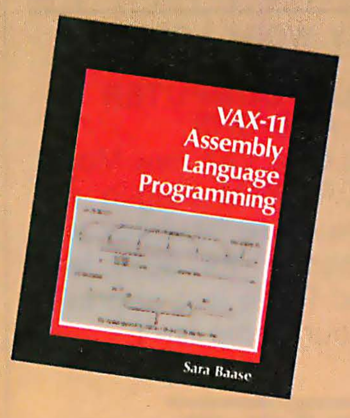
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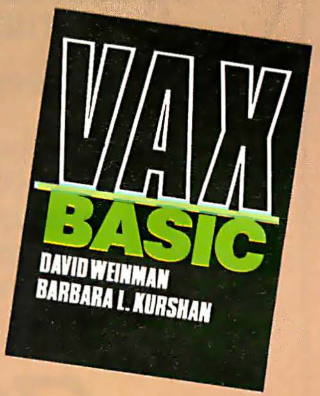
Pascal Under UNIX by J.N.P. Hume & R.C. Holt. $16.95(pa)



Using the UNIX System by Richard Gauthier. $16.95(pa)



VAX-11 Assembly Language Programming by Sara Baase. $28.95(cl)



VAX BASIC by David Weinman & Barbara Kurshan. $16.95(pa)

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on which local area networks are based. The fee is $795. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. *November 28–30*

● SIMULATION CONFERENCE—Winter Simulation Conference, Sheraton Dallas Hotel, Dallas, TX. Papers, tutorials, sessions, and panel discussions will complement commercial exhibits. Contact Udo Pooch, Department of Computer Science, College of Engineering, Texas A&M University, College Station, TX 77843, (409) 845-5498. *November 28–30*

● KIDS SHOW
Bits & Bytes, Disneyland Convention Center, Anaheim, CA. This conference and exposition attempts to show educators, parents, and children how to use computers in the home and classroom. Contact Information Processing Group, Suite 113-150, 350 South Lake Ave., Pasadena, CA 91101, (818) 792-5111. *November 30–December 2*

December 1984

● TELECOMMUNICATIONS CONFERENCES—Telecommunications Programs, various sites throughout the U.S. "Finding Telecommunications Information" and "Satellite Technology for the Nontechnical Manager" will be offered. Contact Phillips Publishing Inc., Suite 1200N, 7315 Wisconsin Ave., Bethesda, MD 20814, (301) 986-0666. *December–January*

● SNA EXPLAINED
Systems Network Architecture, Atlanta, GA. Systems Network Architecture (SNA), IBM's design for an end-to-end communications network, is investigated. Course fee is $795. Contact Elaine Hadden Nicholas, Department of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332-0385, (404) 894-2547. *December 4–6*

● BUSINESS SOFTWARE
Software Connection, Coliseum, New York City. This computer software exposition focuses on business applications. Contact Conference Management Corp., 17 Washington St., Norwalk, CT 06854, (203) 852-0500. *December 5–7*

● OPTICAL, VIDEODISCS CONVOCATION—The Fourth American Videodisc and Optical Disk Conference, Washington Hilton, Washington, DC. Speakers and sessions will highlight this event. Contact Meckler Communications, 520 Riverside Ave., Westport, CT 06880, (203) 226-6967. *December 5–7*

● FIFTH GENERATION COMPUTERS—Fifth Generation and Super Computers: An International Symposium, Rotterdam, The Netherlands. Lectures and panel discussions will be featured. Prototypes of Japanese machines are expected to be shown for the first time outside Japan. Contact Fifth Generation and Super Computers Symposium 1984, Rotterdam Tourist Office, Stadhuisplein 19, 3012 AR Rotterdam, The Netherlands; tel: (010) 14 14 00; Telex: 21228 vvvnl. *December 11–13*

● DEC SHOW
DEXPO West 84, The Sixth National DEC-Compatible Industry Exposition, Disneyland Hotel, Anaheim, CA. Products and services that support Digital Equipment Corporation's machines will be displayed. Contact Expoconsul International Inc., 55 Princeton-Hightstown Rd., Princeton Junction, NJ 08550, (609) 799-1661. *December 11–14*

● TECHNOLOGY UPDATE—Hi-Tech Update '84, Delta Ottawa Hotel, Ottawa, Ontario, Canada. A series of presentations designed to inform senior management, engineers, and consultants. Sponsored by the Carleton University Faculty of Engineering. For further details, contact Conference Coll Inc., 1138 Sherman Dr., Ottawa, Ontario K2C 2M4, Canada, (613) 224-1741. *December 12–13*

● EDUCATIONAL COMPUTING—The Second Annual International Computers in Education Conference, Queen Elizabeth Hotel, Montreal, Quebec, Canada. More than 100 exhibitors and 125 speakers will participate in conferences sponsored by the McGill University Faculty of Education. For more information, contact GEMS Conference and Consulting Services, POB 367, Snowdon, Montreal, Quebec H3X 3T6, Canada, (514) 735-1388. *December 12–14*

● COMPUTERS AND SOFTWARE—The Fourth Annual Southeast Computer Show and Software Exposition, Civic Center, Atlanta, GA. Contact CompuShows, POB 3315, Annapolis, MD 21403, (800) 368-2066; in Annapolis, (301) 263-8044; in Baltimore, (301) 269-7694; in the District of Columbia, (202) 261-1047. *December 13–16* ■

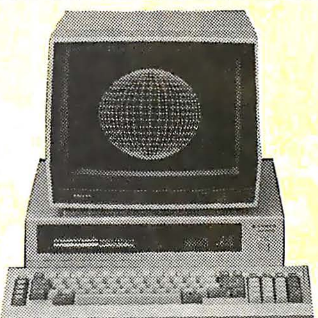
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Microcomputing May 1984

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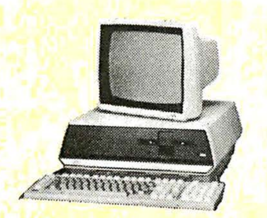


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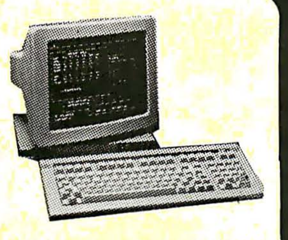


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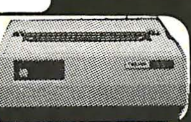
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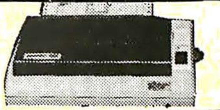
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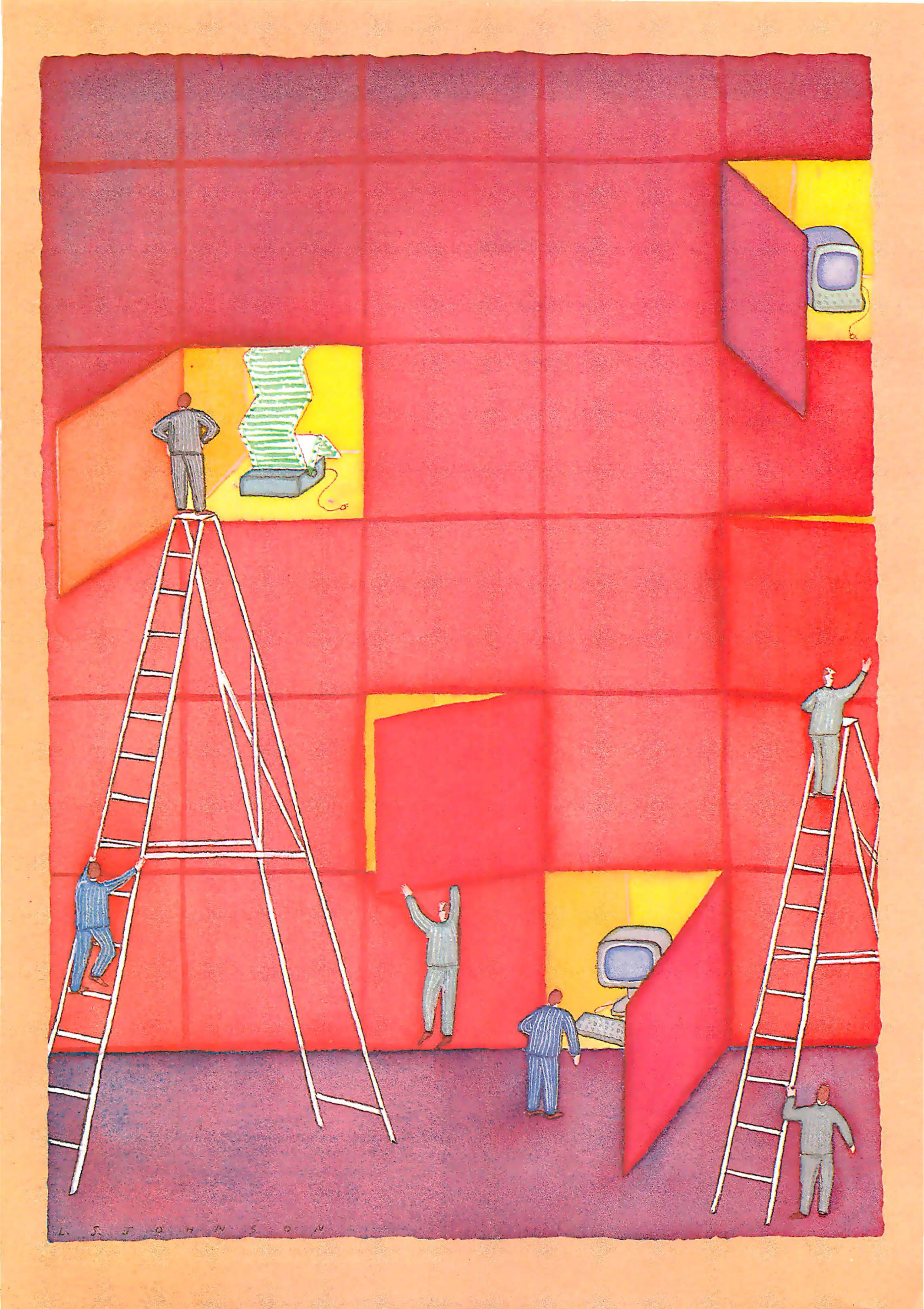
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L. S. JOHNSON

Features

CHASTISED FOR DUMPING the underwhelming PCjr on a new-technology-starved public, IBM blazed forth with its latest marvel, the Personal Computer AT, in mid-August. Our product description of the new machine reveals some curiosities: its Intel 80286 microprocessor runs at only 6 MHz; an upgraded PC-DOS is neither multitasking nor multiuser but does provide support for networking; and the redesigned AT keyboard breaks with the previous ISO standard layout, which will no doubt generate a sigh of relief from the PC-using public. (Alas, the AT cannot be used with prior-model Personal Computers.)

Our Circuit Cellar dweller Steve Ciarcia embarks on an ambitious project to build an ultrasonic ranging device called the SonarTape. It measures distances from 1½ to 35 feet using sound waves. It's the ultimate measuring tape based on a Polaroid ultrasonic transducer. Accurate to ⅒ foot, the SonarTape can be built for about $50.

Computer science has certain recurring themes—difficult problems that ideally test and eventually succumb to the number-crunching power of computing machines. Sorting and prime-number generation are two standard computer problems. The computation of irrational numbers to outrageous decimal places is another. But surely two of the science's favorites are cryptography and random numbers.

These two esoteric disciplines are often interwoven in the search for the ultimate cryptographic key. The generation of random numbers, however, plays a major role in numerous other endeavors, from simulation to statistical analysis. But random-number generation is not as easy as it might seem.

Two articles this month explore these classic problems. Charles Whitney's voyage into the murky world of random numbers shows that testing the random processes for generating these numbers is important but not difficult. Whitney's techniques may prove to be the definitive method for testing the high-level language routines, such as those used by the various purveyors of BASIC, for producing random numbers.

A feature by Charles Kluepfel shows how to build 200-digit cryptographic keys using a modified RSA algorithm and the muMath/muSimp package on an Apple computer. This article is an excellent introduction to both cryptography and to the LISP-like muMath package.

Complex computer-science concepts come to the fore again in Gary Simons's feature on data abstraction. The key to this idea is building data structures that you can manipulate without having to worry about the nature of the data that will eventually populate the structure. Simons explains the concepts of information hiding and abstract data types and presents a practical application of data abstraction in a BASIC program.

The mouse seems here to stay, so BYTE features an article that shows you how to write a driver to adapt a mouse for use with the popular Lotus 1-2-3 software. The technique involves reading the mouse pointer position and interpreting a mouse-click as a carriage return to select menu items.

—G. *Michael Vose, Senior Technical Editor, Features*

THE IBM PC AT

Powerful hardware with a split personality

Editor's Note: *The following is a* BYTE *product description. It is not a review. We provide this advance look at this new product because we feel it is significant. A complete review will follow in a subsequent issue.*

BY BYTE STAFF

Rich Malloy is Product Review editor; G. Michael Vose is Features editor; Tom Clune is a technical editor. They can be contacted at POB 372, *Hancock,* NH 03449.

Exactly three years after the introduction of the IBM PC, IBM announced the PC's second upgrade, the second network for its personal computers, and, finally, a reasonable keyboard.

The new IBM PC AT (advanced technology) has a number of interesting features: a 6-MHz 80286 microprocessor (with 2 to 3 times increased performance over the PC), a 1.2-megabyte minifloppy-disk drive, an optional 20-megabyte hard-disk drive, an enhanced yet compatible expansion bus, the aforementioned keyboard, and an on/off lock switch. On the software side, IBM announced a new version of IBM PC-DOS (3.0), which has some minor improvements and supports networking but not multitasking. However, in the first quarter of 1985, IBM will release TopView, an operating environment that allows multitasking and costs $149, and an 80286-based version of XENIX (UNIX System 3) with multitasking and multiuser capabilities.

The prices for these new products are surprisingly competitive. The base price of an IBM PC AT without the 20-megabyte disk drive is $3995, but a working system in the standard BYTE configuration (two disk drives, 256K bytes of RAM, display, color capability, interfaces, DOS) costs about $5700. In the standard BYTE configuration, plus a 20-megabyte hard-disk drive, total cost is about $6700.

THE SYSTEM UNIT

The system unit is about an inch thicker than the PC. Also, the disk drives are half-height and medium beige. Finally, what looks like an ignition key dangles from the front panel (see photo 1).

The most dramatic changes in the system are inside the unit. First is the 80286 microprocessor, running at a clock speed of 6 MHz. Like the 8086 microprocessor, the 80286 is a true 16-bit microprocessor with both external and internal data buses 16 bits wide. Also, the 80286 has advanced memory-management capabilities that let it access a virtual memory address space of 1 gigabyte.

The 80286 can run under two modes. Under PC-DOS, the 80286 runs in the "real address" mode, in which it emulates an 8086 similar to the 8088 in the IBM PC. In this mode, the 80286 can access only 640K bytes of system memory directly. In the second mode, under XENIX, the 80286 can directly access up to 16 megabytes of physical memory.

IBM claims that the AT performs 2 to 3 times faster than the PC. We expected a 25 percent increase in speed just due to the difference in clock speed. The true 16-bit data bus usually provides another 40 percent increase in processing speed. In actual tests, we found an increase of 150 percent; that is, the AT is 2½ times faster than the PC.

Minimum system memory is 256K bytes; the maximum is 3 megabytes (using five 512K-byte memory expansion cards).

DISK DRIVES

The AT comes with a new type of floppy-disk drive capable of storing 1.2 megabytes of data. These half-height drives achieve this high density by using special disks, a track density of 96 tpi (tracks per inch) as opposed to 48 tpi on the PC, and 15 sectors per track instead of 9 sectors per track as in PC-DOS 2.0. These drives can read standard 360K-byte disks but have trouble writing to these disks in a way that can be read by ordinary 360K-byte disk drives.

The AT has enough space for two of these drives. Or, for more compatibility with the PC, a regular 360K-byte drive can be installed in place of the second high-capacity floppy-disk drive.

In addition to the two possible floppy-disk drives, an optional 20-megabyte hard-disk drive is available for the AT. Also available is

a half-height version of this drive that lets you install two 20-megabyte drives with one floppy.

Other Hardware

The expansion bus in the AT (see photo 2) features some compatibility with the PC but also lets the expansion cards have access to the 80286's extra data and address lines. Two connectors are provided for six of the eight slots. One is the standard 62-pin IBM PC expansion slot connector. Just forward of this is another 36-pin connector for the additional lines.

You can use the lock on the AT's front panel to lock the machine off or on. This lock disables the on/off switch along with the keyboard. It also locks the cover on. For example, if you are running a network or a program that requires a long time to execute, you can lock the system on. This disables the keyboard and prevents passersby from interfering with the system.

The keyboard itself looks perfect. It features oversize Return and Shift keys (see photo 3), and the dreaded Backslash key has been moved up next to the Backspace key. It also has indicator lights for Caps Lock, Num Lock, and Scroll Lock. The keyboard feels and sounds exactly like that of the PC. Also, the keyboard has a long cord that lets you put the system unit on the floor rather than on your desk.

We really like this keyboard, but we have used at least one word processor program (XyWrite II Plus) that does not work with the Caps Lock indicator light. Unfortunately, this keyboard *cannot* be used with the PC.

The AT has serial and parallel interfaces on combination serial/parallel expansion cards. Each card has one serial and one parallel interface. You can use up to two cards in the system. The parallel interface uses a female DB-25 connector, just like the PC, but the serial interface uses a male DB-9 connector. This means you have to buy a special DB-9/DB-25 cable. The reason for this strange connector is probably because the card did not have enough room for another DB-25 connector.

Despite the many rumors, the AT uses the same display adapter cards as the PC. However, these cards fit only in slots 1 or 7.

And IBM finally knows what time it is. The AT has a clock/calendar chip with a small bank of CMOS (complementary metal-oxide semiconductor) RAM powered by a battery. The 50 bytes of CMOS RAM store information such as how much memory is installed and what kind of drives are available. This eliminates the need for DIP switches on the motherboard. In

(continued)

Specifications: IBM PC AT

MANUFACTURER
IBM Entry Systems Division
POB 1328
Boca Raton, FL 33432
(800) 447-4700

PROCESSOR
16/16-bit Intel 80286, 6-MHz clock rate

MEMORY
256K bytes to 3 megabytes

DISK DRIVES
One 5¼-inch 1.2-megabyte floppy drive
Optional 20-megabyte hard disk
Optional 5¼-inch 360K-byte drive

OPERATING SYSTEM
IBM PC-DOS 3.0
Available soon: DOS 3.1 and XENIX

SOFTWARE
IBM PC BASIC 3.0

PRICE
With 1.2-megabyte disk drive $3995
Above with monochrome display, color graphics card, interfaces, second disk drive, and DOS . . $5469
With 1.2-megabyte drive, 20-megabyte hard-disk drive, interfaces, and 512K bytes of memory . . $5795
Above with monochrome display, color graphics card, and DOS $6694



Photo 1: *The IBM PC AT with a 20-megabyte hard-disk drive. This unit is equipped with an IBM monochrome monitor and a second, 360K-byte floppy-disk drive. Note the switch lock on the front panel.*

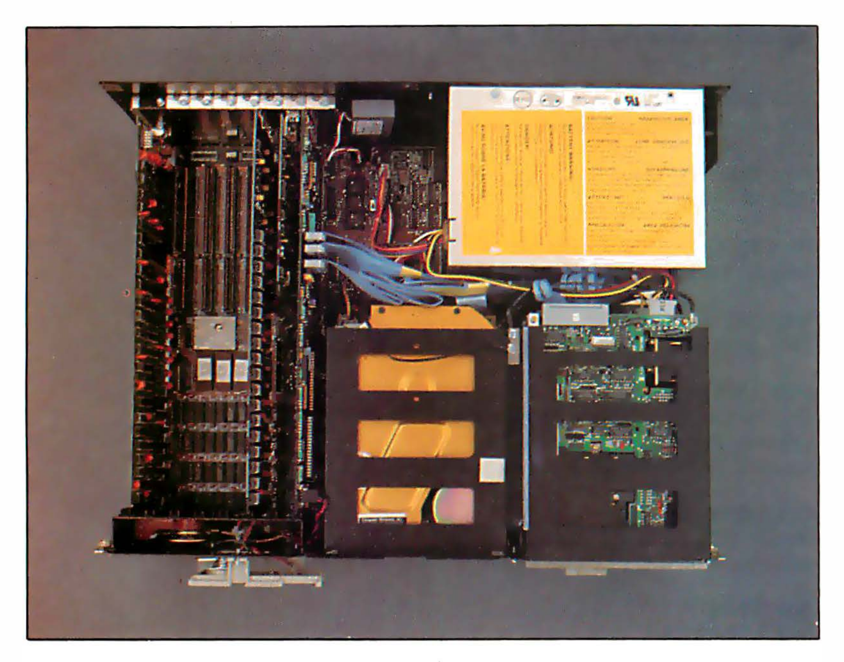






Photo 2: *Inside the IBM PC AT. The expansion bus is at the left. Note the connectors for extra address and data lines. A 20-megabyte hard disk is in the lower middle. The power supply is in the upper right.*
Photo 3: *Close-ups of the IBM PC AT keyboard. Note the proper position of the Shift key (left). Also note the indicator lights in the upper right and the large size of the Return (Enter) key (right).*

fact, the only real switch on the motherboard is a poorly labeled slide switch that tells the system what type of display is attached.

PC-DOS 3.0

An enhanced version of the PC-DOS operating system drives the IBM PC AT. Labeled version 3.0, it provides a software upgrade path within the PC product line while accommodating the hardware differences of the AT's architecture. The new DOS runs on IBM PCs and XTs and the PCjr as well as the AT.

The first time you use PC-DOS 3.0, you must run a startup routine. The routine defines the system's hardware—how many disk drives are installed, how much memory is installed, etc., and this information is stored in the above-mentioned CMOS RAM. This setup information is referenced each time you turn on the computer.

PC-DOS 3.0 supports the high-capacity (1.2-megabyte) floppy disks as well as the standard single- and double-sided floppies and one or two fixed disks. These disks can be used in a variety of combinations.

The high-density floppies can store 600K bytes of information per side on 80 tracks, with 15 sectors per track. Four enhanced PC-DOS 3.0 commands, Format, Backup, and Diskcomp/Diskcopy, provide support for this new class of floppy disk.

Enhancements to Backup also permit selective backup in three categories: backup of files modified since the last backup, addition of new files to a backup disk, and backup of files modified after a certain date.

Perhaps the most significant new command is Device, which permits the installation of virtual disks. Virtual disks, often called RAM disks, can number up to 24 in PC-DOS 3.0. In IBM PC ATs with extended memory, it is possible to locate virtual disks above the 1-megabyte boundary.

Version 3.0 of PC-DOS comes with three manuals and a quick reference card. The *User's Guide* is an introduction to PC-DOS written for the novice user and covers the basics of the operating system with simple text and color graphics. An *Applications Setup Guide* prompts you through the process of porting existing PC-DOS applications over to version 3.0. The DOS reference manual is a standard three-ring, loose-leaf binder with documentation similar to previous versions. A technical reference for software developers is available at extra cost.

BASIC, TopView, and XENIX

Version 3.0 of BASIC incorporates several extensions.

The SHELL statement loads and executes a program file (called a child process) that can be run from the system level from BASIC. If the file executed is a .BAT file ending in EXIT, control is returned to BASIC. There is a wide variety of conditions under which SHELL might cause the system to crash, including accessing the DMA controller, interrupt controller, I/O (input/output) latch, or counter timer from a child process, or altering any file opened from BASIC from a child process.

The ENVIRON$ function returns information on BASIC's environment table (position in DOS directory). The ENVIRON statement modifies BASIC's environment table.

TopView is a separate software package that contains what we expected to find in PC-DOS 3.0. It will be released in the first quarter of 1985. TopView is an interesting multitasking environment with windowing capability. The demonstration we saw of TopView showed that you can use it with a mouse to set up windows that can execute applications concurrently.

At $149, this package will compete against Digital Research's Concurrent PC-DOS (Concurrent CP/M-86 version 3.1 with PC-DOS emulation), which is similar in features and price. However, Concurrent PC-DOS can also run CP/M-86 applications.

As is the case with TopView, we have not yet received XENIX for this system (release date is also set for the first quarter of 1985), but we have seen a demonstration. It is limited to three users (because of the AT's two-serial-port limitation). Also, it has a nice user shell that looks very much like Multiplan. In fact, as of this writing, Multiplan is the only application program that IBM has for XENIX.

PC INCOMPATIBILITY

IBM states that the following PC hardware products will not work with the AT: the standard PC keyboard, the parallel-printer adapter card, the 64K to 256K-byte memory cards, the asynchronous communications (serial port) card, and the expansion unit. We have not yet tested any of the numerous third-party expansion cards, but we are not optimistic.

As for software, IBM states that the following programs (among others) will not run: BPI Systems Accounting (1.0); Peachtree Accounting (1.0); EasyWriter (1.0); pfs:File and Report (1.0); VisiCalc (1.0 and 1.1); and BASIC (1.X and 2.X). We were disappointed to find that Microsoft's Flight Simulator would not work. Most other programs that we have tried (WordStar, Lotus 1-2-3, Multiplan, PeachText) do work.

Technically, IBM states that the AT might not be able to run PC programs that include memory-specific commands such as POKE; programming loops to control timing; back-to-back I/O commands to the same port (because of insufficient recovery time); the PUSH SP command (this command on the AT pushes the current stack pointer, while the PC pushes the new stack pointer); and the divide-error exception (the AT pushes the address of the instruction causing the interrupt, while the PC pushes the next instruction's address).

CONCLUSIONS

All testing we have done with the AT to date has involved only the real address mode (under DOS 3.0). Under this mode, we have found that the AT provides an increase of 2½ times the processing speed of the PC. We have no indication of how it will perform under XENIX in the multiuser environment.

The AT might be of interest in data-acquisition applications. The system comes with 16 interrupt levels and 7 channels of DMA. The DMA controller operates at 3 MHz, which is relatively fast. DMA channels 0 through 3 support 8-bit transfers throughout the system's 16-megabyte physical address space in 64K-byte blocks. Channels 5 to 7 support 16-bit transfers in 128K-byte blocks. Channel 4 cascades channels 0 to 3 to the 80286. IBM has documented the AT's DMA controller in the *Technical Reference Manual*. The PC and XT are a little too slow to keep up with the output of most high-speed data-acquisition systems, so the AT might find a home in these applications.

The IBM PC AT is an impressive machine, but the most important reason for its existence has yet to arrive—a powerful multiuser operating system such as UNIX. When XENIX is available, we'll be able to give a more complete evaluation of this system. For now, the AT represents a solution for applications that are taxing the PC and XT to their limits. ■

THE IBM PC NETWORK

BY GEORGE BOND

IBM's entry into the microcomputer local-area network field probably will have an impact similar to that of the original IBM PC on the personal computer field—big.

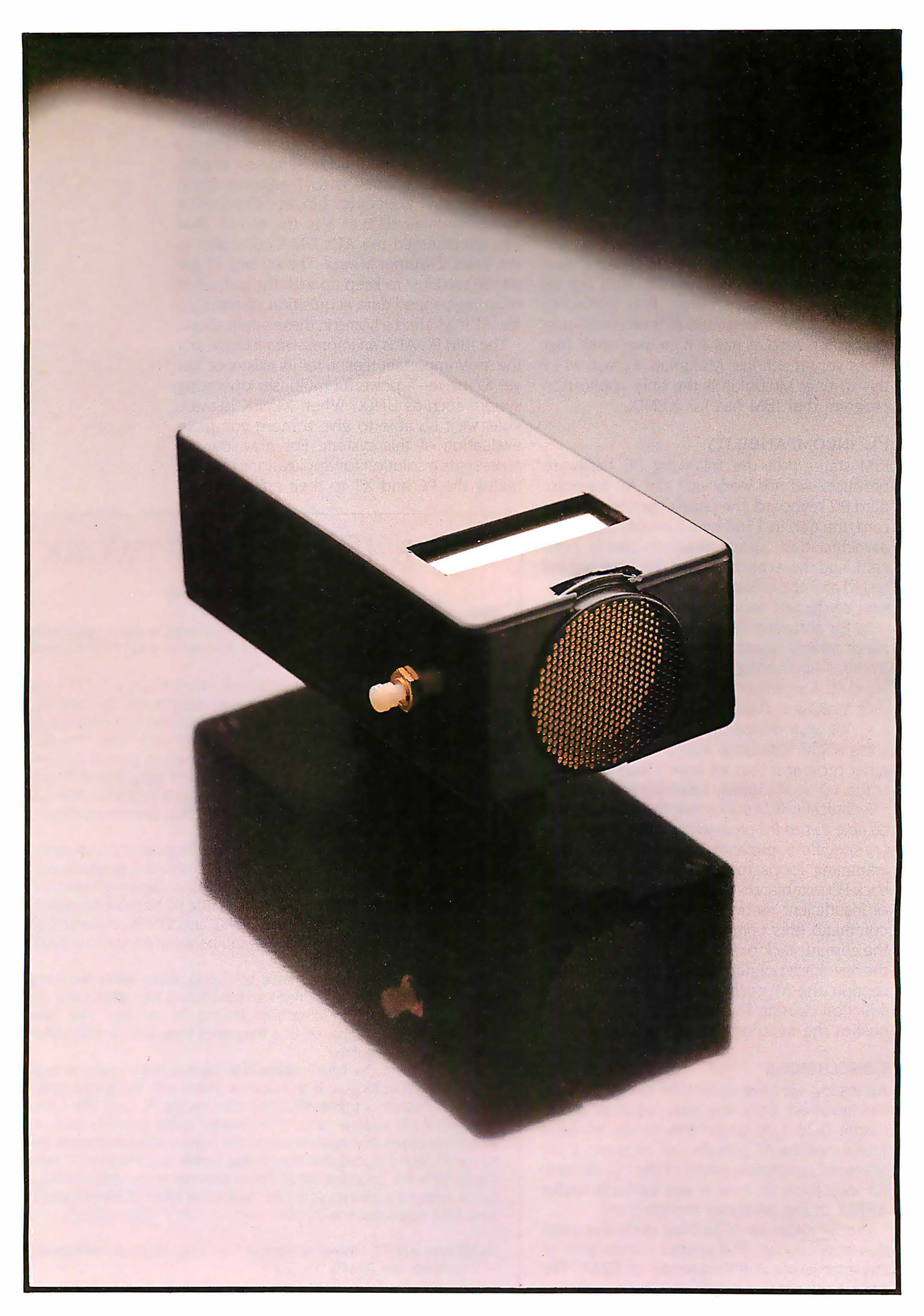
The company introduced a local-area network (LAN) for PCs and an emulation program to give PCs access to mainframes. The IBM PC Network Program is the LAN. It is designed to connect PC-family machines, except for the PCjr and PC Expansion Unit, to each other. The IBM PC Network SNA 3270 Emulation Program is meant to provide System/370 mainframe applications to PCs on the PC network using IBM 3270 or SDLC (synchronous data-link control) communications protocols. The LAN is scheduled for release in the first quarter of 1985, and the emulation program by midyear 1985.

The PC Network uses standard broadband hardware components and is designed for user installation. It transmits data at 2 megabits per second using carrier-sense multiple-access/collision-detect (CSMA/CD) protocol. The physical network consists of an IBM PC Network Translator Unit ($595), IBM PC Network Adapters ($695), and IBM PC Network Cabling Components. As many as 72 nodes can be attached within a 1000-foot radius of the translator unit.

The network adapter unit (made by Sytek), which looks like a regular add-in board for the PC, includes an Intel 80188 microprocessor and an 82586 communications controller among its circuitry. The Network Translator Unit is composed of a frequency translator, a directional tap, and an eight-way splitter.

IBM's vision of the future appears to be just that—vision. It is giving strong hints that its goal is to combine video with voice and computer data transmission, a prime AT&T objective, on the PC LAN. The LAN uses standard RG-11 coaxial cable, a broadband cable found in cable television installations. IBM notes in one of the printed announcements relating to the AT introductions that the cabling system and the IBM PC Network media have the "inherent capability to transmit voice, video (using additional vendor equipment), and data." In another piece of introductory literature, IBM notes that the 75-ohm coax is "CATV compatible."

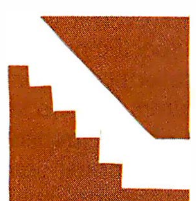
George Bond is BYTE's *managing editor for* User News. *He can be contacted at* POB 372, *Hancock,* NH 03449.



AN ULTRASONIC RANGING SYSTEM

BY STEVE CIARCIA

Build the SonarTape



Those of you who have followed the Circuit Cellar projects over the years will recognize that I have discussed sonar and ultrasonic ranging before. November 1980's "Home In on the Range! An Ultrasonic Ranging System" used the Polaroid Ultrasonic Ranging System Designer's Kit. This $150 kit, based on a modified, custom-manufactured sonar-ranging circuit board from Texas Instruments for Polaroid's SX-70 camera, greatly simplified the circuitry normally associated with ultrasonics. The November 1980 project described circuit additions that facilitated connection of the ranging kit to a computer's I/O (input/output) port.

To my knowledge, these kits are still available from Polaroid if you are interested in producing the stepper-motor-driven scanning system described in the original article. However, if you are looking for a cost-effective distance sensor for your computer, you'll be happy to know that LSI (large-scale integration) technology did not stand still in the interim. Texas Instruments introduced a new sonar-ranging module that is both cost-effective and simple to integrate into computer-based systems.

I'll first describe this new module in detail and then demonstrate how easily you can attach it to a computer or use it independently with an LCD (liquid-crystal display) to create an electronic tape measure.

THE SONAR-RANGING MODULE

The latest Texas Instruments sonar-ranging module, the SN28827, is actually an updated and higher-functioning version of the original SX-70 module, both of which are shown in photo 1. The newer unit has similar performance characteristics but requires far less support circuitry and interfacing hardware. It is designed to drive a 50-kHz 300-volt (V) electrostatic transducer, which Polaroid is still manufacturing. The module and the transducer are the only components necessary to measure distances from 1.33 to 35 feet with an accuracy of ±2 percent.

In operation, a pulse is transmitted toward a target and the resulting echo detected. The elapsed time between the transmission and echo detection is a function of the distance to the target. Basically, this distance in feet is simply the elapsed time in seconds (actually milliseconds) multiplied by the speed of sound in feet per second

(continued)

Steve Ciarcia (pronounced "see-ARE-see-ah") is an electronics engineer and computer consultant with experience in process control, digital design, nuclear instrumentation, and product development. He is the author of several books about electronics. You can write to him at POB 582, Glastonbury, CT 06033.

Specifications

Minimum Transmitting Sensitivity at 50 kHz 300 V AC peak to peak, 150 V DC bias (dB re 20 μPa at 1 meter)	110 dB
Minimum Receiving Sensitivity at 50 kHz 150 V DC bias (dB re 1 V/Pa)	−42 dB
Suggested DC Bias Voltage	150 V
Suggested AC Driving Voltage (peak)	150 V
Maximum Combined Voltage	400 V
Capacitance at 1 kHz (typical) 150 V DC bias	400–500 pF
Operating Conditions Temperature Relative Humidity	 32°–140° F 5%–95%
Standard Finish Foil Housing	 Gold Flat Black

Figure 1: *Specifications for the Polaroid electrostatic transducer.*

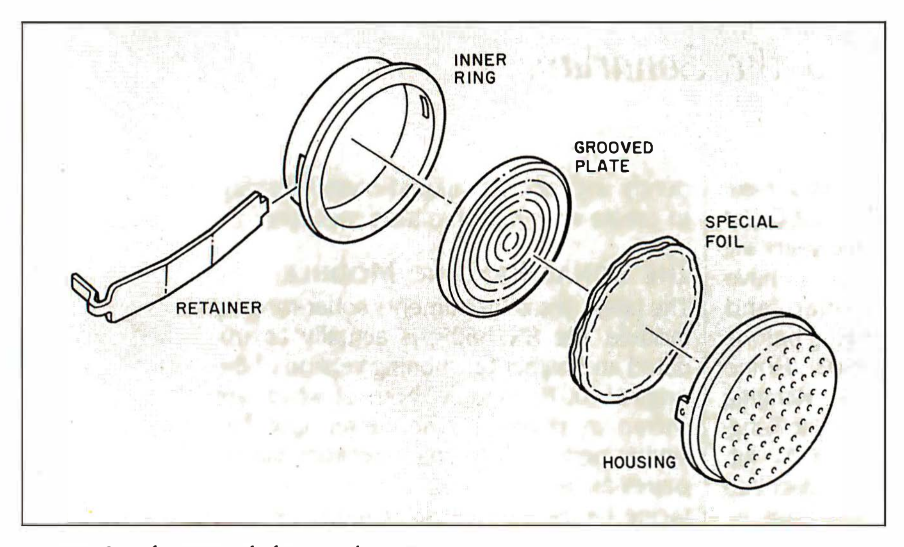


Figure 2: *The parts of the transducer.*

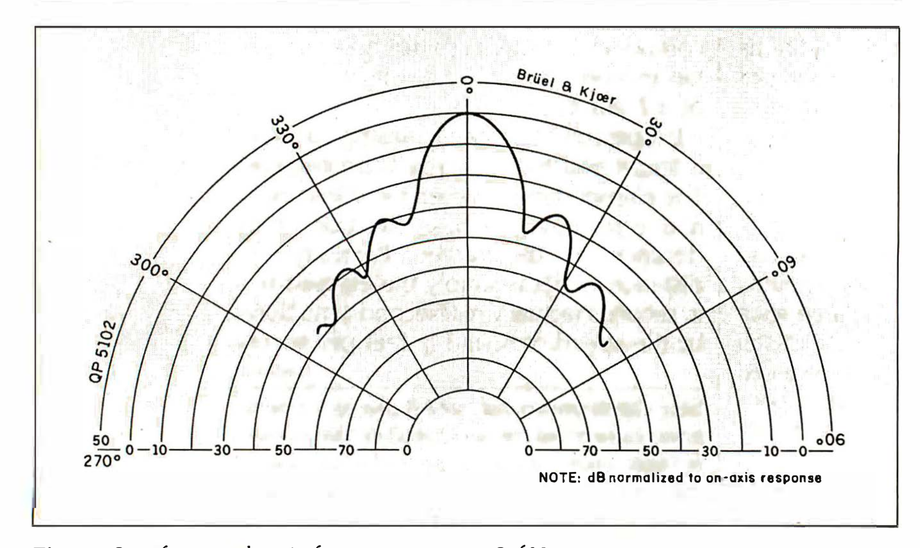


Figure 3: *The transducer's beam pattern at 50 kHz*

(approximately 1100 ft/sec). More specifically, the rate is 1.78 milliseconds (ms) per round-trip foot. It takes 3.55 ms for a pulse to leave the transducer, strike a target 2 feet away, and return to the transducer.

The transducer most frequently used with this module is the instrument-grade Polaroid electrostatic transducer (see figure 1 for its specifications), which acts as a speaker in the transmit mode and a microphone in the receive mode. The transducer (shown in photo 2 and disassembled into its component parts in figure 2) is 1.5 inches in diameter and consists of a 3-millimeter gold-plated foil stretched over a concentrically grooved aluminum disc.

The foil, electrically insulated yet bonded closely to the metallic backplate, forms a capacitor. The foil is the moving element in the transducer that converts electrical energy into sound and the returning echo into electrical energy.

The Polaroid sensor is larger and, in my opinion, considerably more expensive than other 50-kHz transducers. However, it is designed this way for a specific purpose. (I've tried 50-kHz transducers from two other manufacturers with no success.) The diameter of the transducer determines its directional sensitivity. The Polaroid unit is extremely directional, as indicated in the graph of acoustical-signal strength shown in figure 3.

Operating the Module

The sonar-ranging module (pictured in photo 3 and diagramed in figure 4) is a two-chip, 2- by 2-inch module. It is a 12-component, custom-manufactured module built around the Texas Instruments TL851 and TL852 sonar-ranging controller/receiver chip set. In small quantities, the assembled module is far less expensive than the individual components, and it eliminates the ever-present aggravation of finding the correct coils and chokes. Electrical connection is made through an eight-conductor flat ribbon cable or direct solder attachment to the connector base, which contains three output lines, three input lines, power, and ground.

The two basic modes of operation for the module are single echo and multiple echo. The single-echo mode

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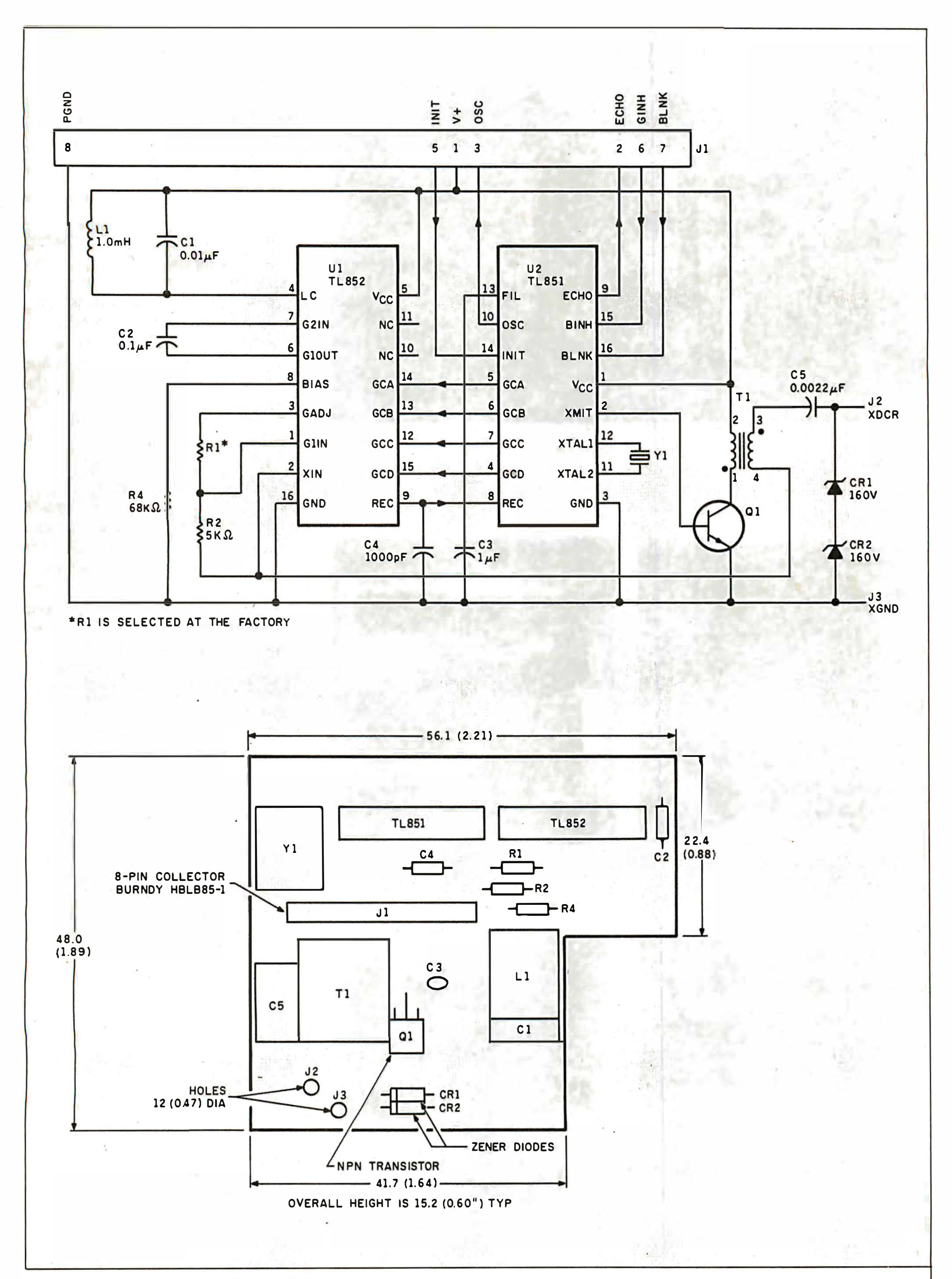


Figure 4: *The schematic and layout of the Texas Instruments sonar-ranging module.*

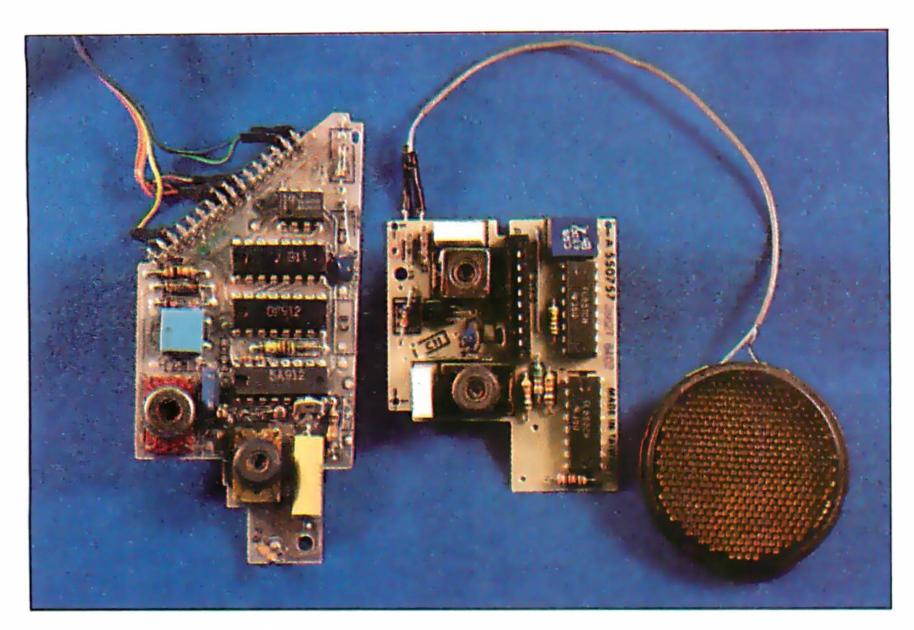


Photo 1: *The original Texas Instruments ultrasonic ranging module (left) provided in the experimenter's kit from Polaroid compared to the new TI ranging module (right) that is the basis of this article.*



Photo 2: *A close-up of the Polaroid ultrasonic transducer.*

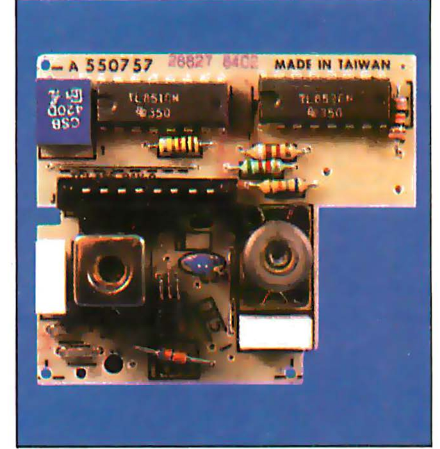


Photo 3: *A close-up of the TI ranging module.*

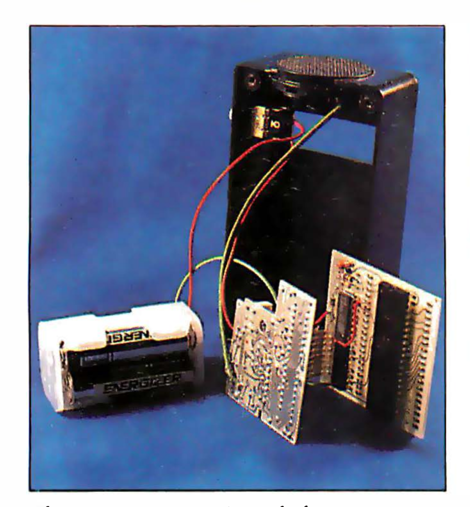


Photo 4: *A rear view of the disassembled tape measure.*



Photo 5: *A front view of the disassembled tape measure.*

implies that only one target exists and that a single ranging value is desired. In the multiple-echo mode, the echo monitoring time is extended to "hear" the echo from objects farther away than the closest target. Differentiating among these echoes can be a data-reduction nightmare, so I will limit my discussion and the use of the ranging module to the single-echo mode.

Figure 5 is the basic timing diagram of the ranging module. Within 5 ms of applying power (at 4.5 V to 6.8 V), the internal circuitry has reset and stabilized and the module is ready. The distance-measuring sequence is activated by raising the INIT input line to a logic 1 state. This enables the 420-kHz on-board ceramic resonator, and 16 cycles of a 300-V 49.4-kHz (420 kHz divided by 8.5) signal are generated. The 16 cycles are passed through a driver/transformer combination that boosts the signal's magnitude to 300 V at the transducer. At the end of the 16 cycles, a DC bias of 150 V remains on the transducer for optimum operation, and the oscillator output steps up to 93 kHz (420 kHz divided by 4.5), where it remains as long as INIT is high.

In order to prevent any ringing in the transducer from being detected as a return signal, the receive input of the ranging control IC (integrated circuit) is inhibited by an internal blanking signal for 2.38 ms. This blanking interval corresponds to 1.33 feet, which is the minimum distance that the ranging module can sense without external control intervention. To detect objects closer than 1.33 feet, the blanking inhibit line, BINH, can be taken high prior to 2.38 ms to enable the receiver.

In the single-echo mode, all that must be done is to wait for the echo from the target. After INIT, the transmitted pulse travels at a rate of 0.9 ms per foot. When the ranging module hears the echo, the ECHO output line goes high. The difference in time between INIT and ECHO both going high is a measure of the distance to the target. This elapsed time can be measured through a timing loop in a computer or gated with the oscillator output to increment a counter and drive a display. I will explore both of these techniques.

One final note on the ranging-module electronics. If you have experimented with ultrasonics, you've

probably found, as I have, that fixed-distance reception is far easier to accomplish than variable-distance reception. Sound intensity decreases geometrically proportional to increases in distance. If you have designed a transmitter-and-receiver system that works well at 6 feet, it may not function at 12 feet without substantially increasing the receiver sensitivity (gain) to account for the reduced echo amplitude. Leaving the sensitivity at a high level and reducing the distance again invites other interference and false-echo-detection problems. To adequately compensate for changing distances, the sensitivity setting must also be adjustable with distance.

The TI ranging module dynamically tailors the receive amplifier's sensitivity. Lower amplification is needed for close objects, higher amplification for distant echoes. Twelve gain steps within the range of 0 to 35 feet are automatically incremented as the time between INIT and ECHO lengthens. If the distance is 6 feet, the receiver will be at its second gain setting. At 20 feet it will be at its sixth level. The twelfth level is sufficient for unaided reception of echoes from 35 feet. The addition of a direction cone to the transducer, which will further improve sensitivity, will facilitate measuring distances beyond 35 feet.

Computer Connection

Figure 6 is the schematic for connecting the ranging module to the parallel port of a computer. The entire single-echo-mode interface requires only 1 input bit and 1 output bit. The output bit connects to the INIT line; the input bit connects to the ECHO line. To measure distance, the computer merely raises the INIT line and measures the time until ECHO goes high. The repetition rate depends on the distance. The cycle is repeated when INIT is lowered and raised again. This can occur at any point after ECHO. For short distances, a 100-Hz repetition rate is possible. To allow a full 35-foot range, however, the repetition rate should be limited to 10 Hz.

Unlike the Polaroid Designer's Kit, which is specified to run on 6 V, the TI ranging module can function between 4.5 and 6.8 V. If you use a 5-V supply, the ranging module I/O is TTL

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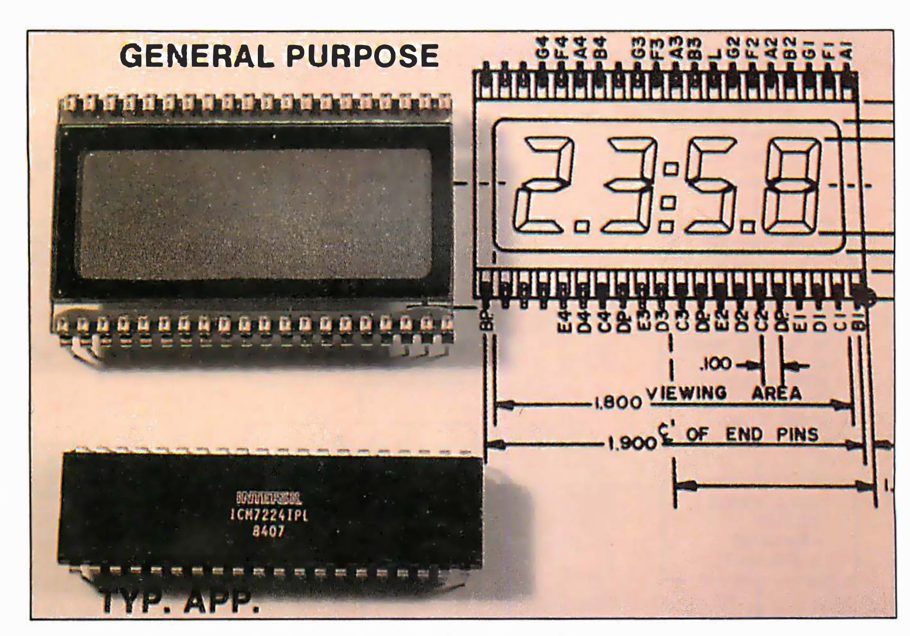


Photo 6: *With the addition of the 4-digit LCD, such as the UXD unit shown, and a 4½-digit 7224 LCD counter/decoder/driver chip from Intersil, a hand-held tape measure can be easily constructed.*

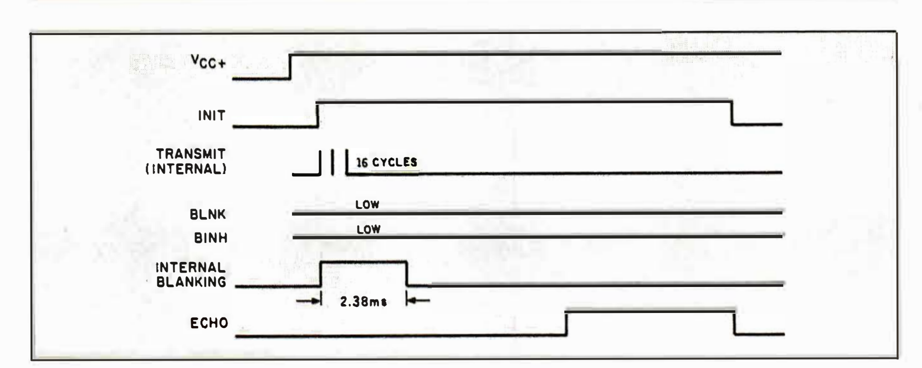


Figure 5: *A timing diagram of the sonar-ranging module.*

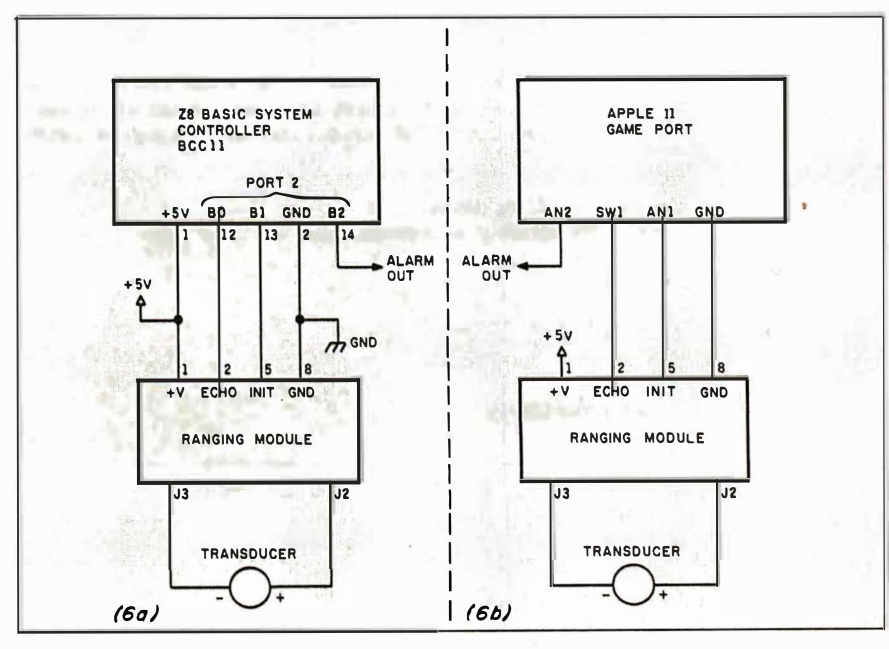


Figure 6: *The sonar-ranging module's connection to the Z8 BASIC system controller (6a) and to the Apple II system controller (6b).*

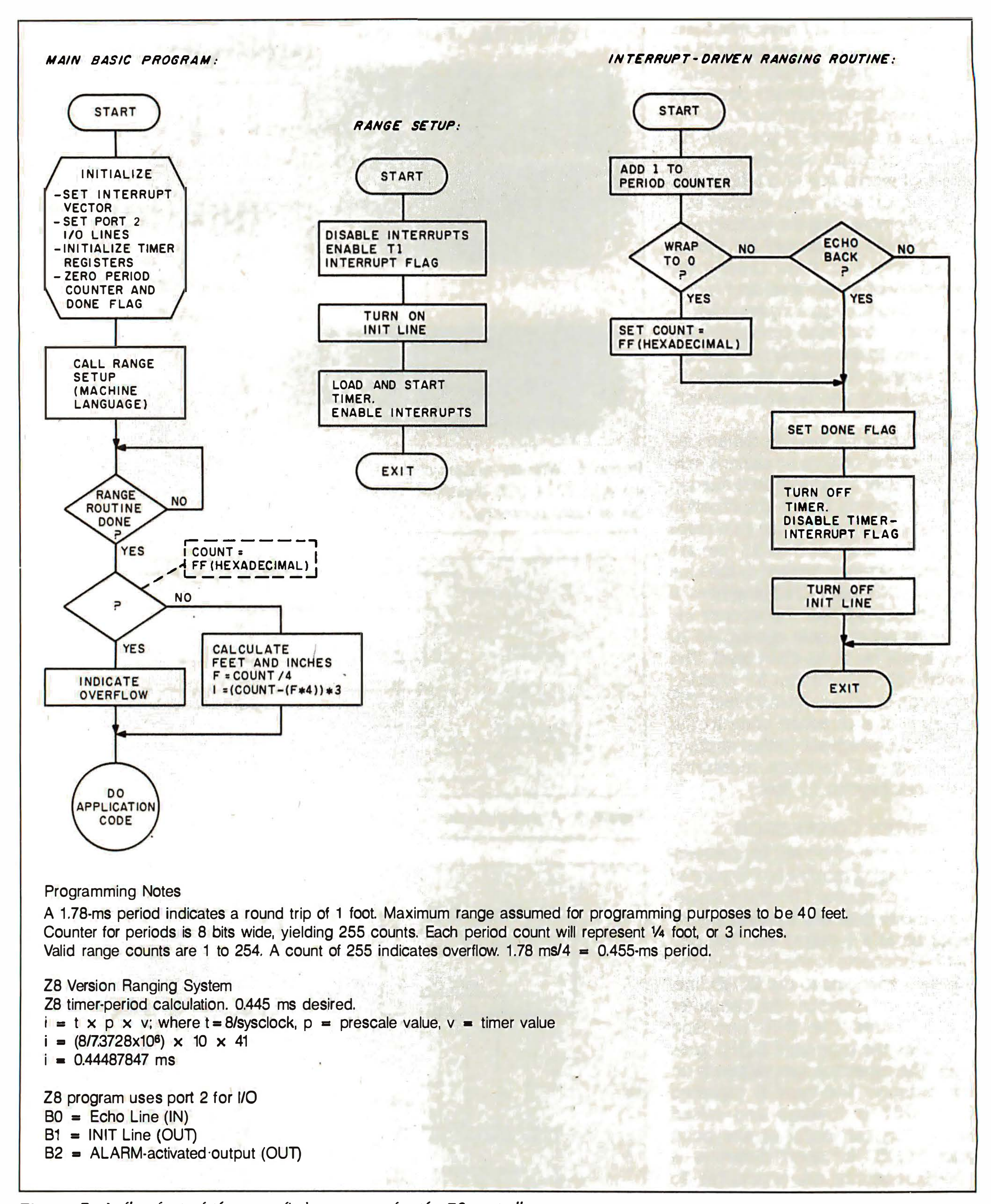


Figure 7: A *flowchart of the range-finder program for the Z8 controller.*

(transistor-transistor logic) compatible and can be connected directly to most computers. The module normally requires about 100 milliamperes (mA) except during the 16-cycle transmission period, when it can reach 2 amperes (A). Any power source intended for use with the module should have an intermittent power rating this high. For portable operation, you can use either standard AA or larger alkaline batteries or Polaroid's Polapulse high-current batteries.

For the purposes of this article, I chose to demonstrate connection of the ranging module to an Apple II and the Z8 system-controller board, which

is an improved descendant of the original Z8-based computer controller presented in the June and July 1980 Circuit Cellar articles. The description of connecting the ranging module to the Z8 system controller through a parallel I/O port, measuring the elapsed time in a callable machine-language routine, and manipulating the results within the tiny BASIC interpreter are transferable in principle to any computer. (I have since had a Z8 FORTH chip produced that is interchangeable with the Z8671 tiny BASIC chip. The FORTH chip could also have been used.) By using the Z8 board, however, I can produce a dedicated measuring system that can sense and average a number of readings, make decisions, activate specific control outputs, and communicate readings to larger host systems serially.

Figure 7 is a block diagram of the necessary steps to initialize the module and measure distance with the Z8. Figure 8 is a block diagram of the Apple II version of the same code. Figure 9 is the block diagram of a typical proximity-detector application with alarm outputs. Listings 1, 2, and 3 show the code to perform these tasks.

Electronic Tape Measure

While describing the electrical characteristics and computer connection of the ranging module might ordinarily suffice as a Circuit Cellar project, I was intrigued by the simplicity of using the ranging module and decided to build the electronic tape measure shown in photos 4 and 5. The circuit shown in figure 10 required only three additional CMOS (complementary metal-oxide semiconductor) chips and can be constructed as a hand-held device.

The Circuit Cellar Sonar Tape Measure, hereafter called SonarTape, consists of the TI ranging module, a CD4049 inverter, a CD4029 counter, and an Intersil ICM7224 4½-digit LCD counter/decoder/driver chip (shown in photo 6). When pointed at an object or a wall and activated, the SonarTape transmits once and holds its reading (so that you can turn the unit and see the display if it wasn't already in view). The LCD indicates the distance in feet and tenths of feet.

The SonarTape is activated by turning on the power (6 V provided by

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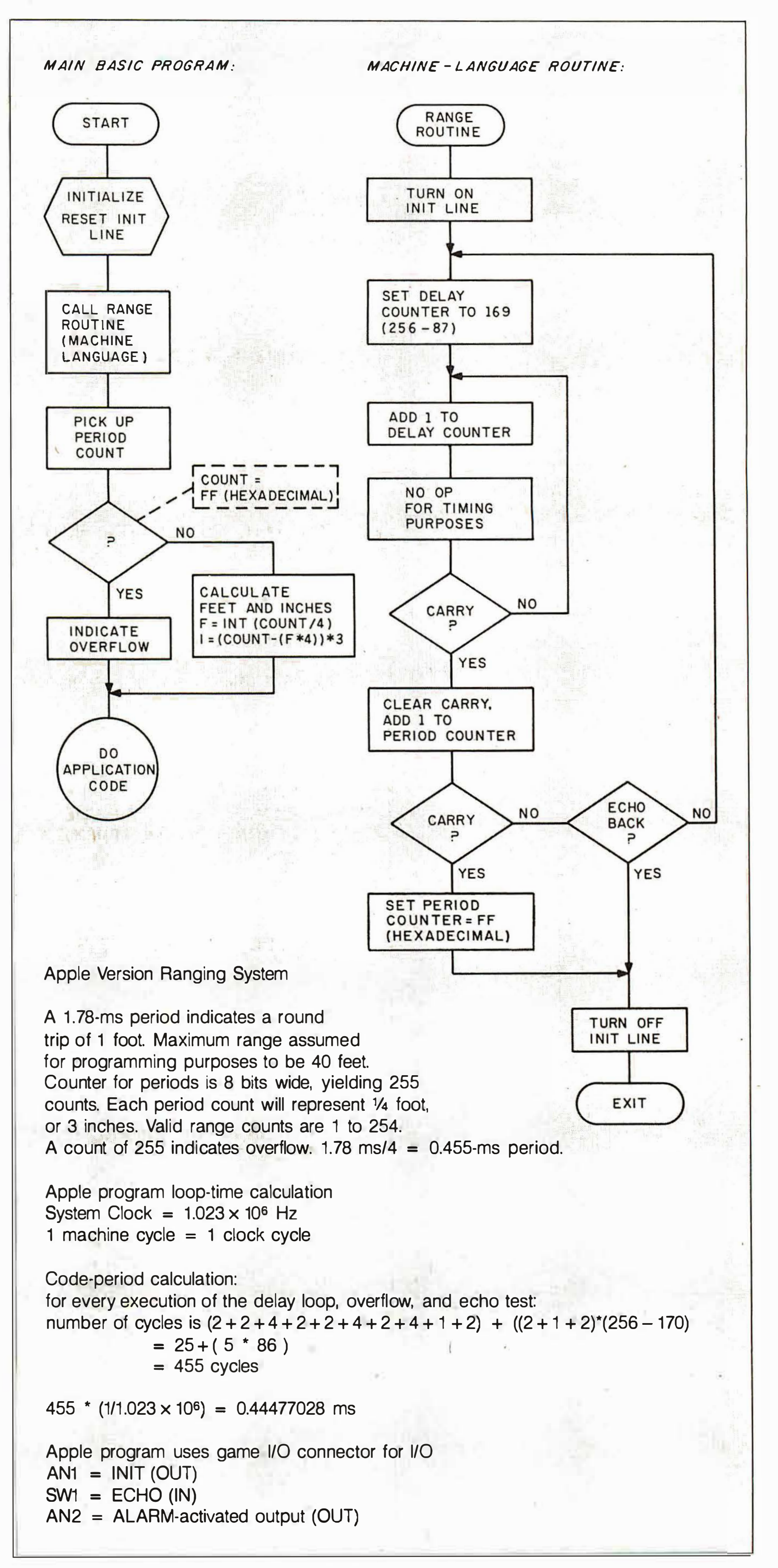


Figure 8: *A flowchart of the range-finder program for the Apple II.*

four AA alkaline cells) to the circuit through a momentary push button. A resistor/capacitor timing circuit connected to V_{cc} and attached to pin 3 of IC1 resets IC3, presets IC2, and keeps the INIT input line to the ranging module low until the 5-ms power-on stabilization time has passed. When the capacitor charges up to a logic 1 level, the INIT line goes to a logic 1, allowing the ranging module to transmit.

Once the INIT line goes high, the clock output, CLOCK, from the ranging module is enabled, and a 93.333-kHz clock (after the first 16 cycles at 49.4 kHz) is presented to the clock input of IC2. Configured as a divide-by-16 counter, the carry output, pin 7, will be at 5.83333 kHz. This frequency is connected to the count input of the counter/decoder/driver chip, IC3, which continues to count input pulses (started when INIT went high) until the ECHO line, connected through an in-

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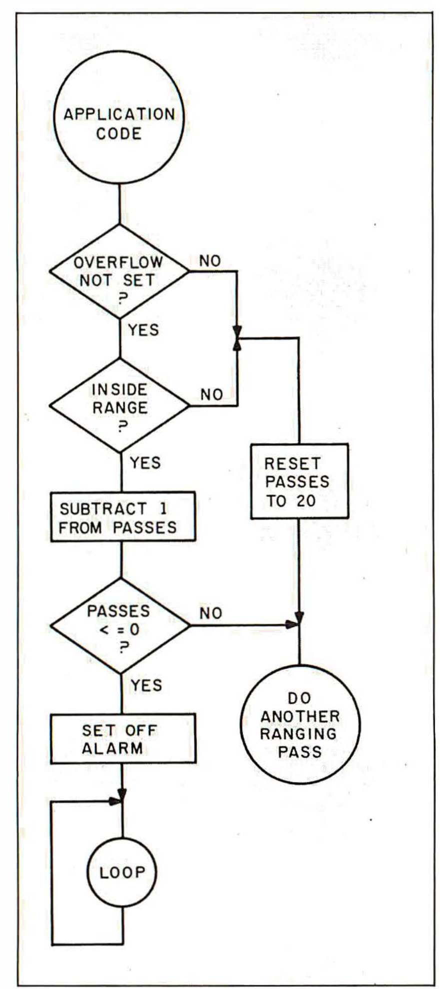


Figure 9: *A flowchart of the alarm-monitor program.*

Listing 1: *The Z8 programs to initialize the ranging module, measure the distance, and print the results. The BASIC program (1a) initializes the module and calls the machine-language routine, represented here in assembly language (1b). The machine-language program oversees the distance measurement. Finally, the BASIC program prints the results (1c). Remember to delete the REM statements.*

(1a)

```
1 REM Z8 BASIC PROGRAM FOR RANGE FINDER
10 @%100F=%8D:@%1010=%15:@%1011=%0C   :REM SET UP INTERRUPT
                                       VECTOR
20 @246=%F9:@2=0                      :REM SET UP PORT 2 I/O.
                                       RESET INIT LINE
30 @243=%2B:@242=41                   :REM SET UP TIMER
                                       REGISTERS
40 @%30=0:@%31=0                      :REM ZERO COUNTER
                                       AND DONE FLAG
50 GO @%1500                          :REM CALL RANGE-SETUP
                                       ROUTINE
60 REM LOOP UNTIL DONE FLAG SET
70 IF @%31=0THEN60                    :REM TEST DONE FLAG
                                       AND LOOP
80 C=@%30                             :REM PICK UP COUNT
                                       VALUE
90 F=0:I=0:O=0                        :REM CLEAR FEET,
                                       INCHES, OVERFLOW
100 IF C=%FF THEN 0=1:GOTO 130        :REM SET OVERFLOW IF
                                       COUNT=%FF
110 F=C/4                             :REM CALCULATE FEET
120 I=(C-(F*4))*3                     :REM AND INCHES
130 REM APPLICATION CODE STARTS HERE
140 IF O=1 THEN PRINT "OVERFLOW":GOTO 40
150 PRINT F; " FEET ";I;" INCHES"
160 PRINT C; " .445-MS PERIODS COUNTED"
170 GOTO 40
:
:
:
:NOTE: DO NOT ENTER THE :REM STATEMENTS, OR THE PROGRAM WILL NOT
RUN.
```

(1b)

```
0010 ;
0020 ; Z8 VERSION RANGE-FINDER ROUTINES
0030 ;
0040 ; DRIVE INIT LINE AND SET UP CLOCKS
0050 ;
0060          ORG    1500H
0070 INIT     EQU    $
0080          DI                 ; SHUT DOWN INTERRUPTS
0090          OR     IMR,#20H    ; ENABLE IRQ 5 (TIMER 1)
0100          LD     02H,#02     ; TURN ON INIT LINE
0110          OR     TMR,#0CH    ; LOAD AND START TIMER 1
0120          EI                 ; ENABLE INTERRUPTS
0130          RET                ; RETURN TO BASIC
0140 ;
0150 ;
0160 ; THIS IS THE INTERRUPT-DRIVEN RANGING ROUTINE
0170 ;
0180 ;
0190 RANGE    EQU    $
0200          INC    30H         ; ADD 1 TO PERIOD COUNTER
0210          JR     NZ,ECHO     ; IF NO WRAP, CHECK ECHO
0220          LD     30H,#0FFH   ; SET COUNT TO %FF
0230          JR     DONE        ; AND SHUT DOWN RANGE ROUTINE
```

(continued)

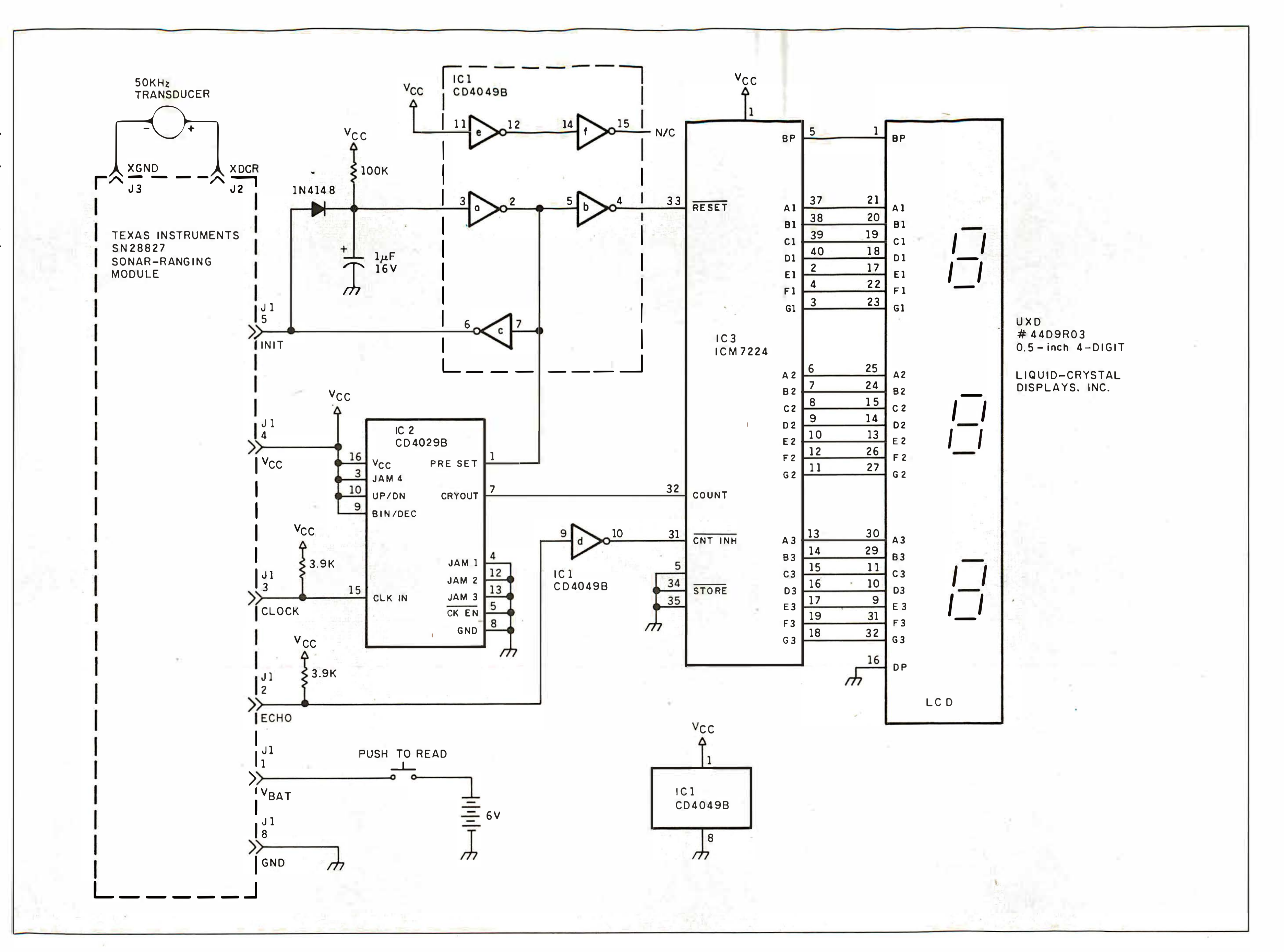


Figure 10: *The schematic of the SonarTape.*

A sonar sensor would let a sightless person "hear" a picture of the environment.

verter to the count-inhibit line on IC3, goes high, indicating reception of the echo. Clock pulses will therefore have been counted during the elapsed time period between INIT and ECHO.

If the elapsed time were 6 ms, about 34 clock cycles would have been counted by IC3. With the decimal point permanently set between the least and next most significant digit, the indication on the LCD would have been 3.4 feet. Similarly, 31 ms of elapsed time would allow about 175 cycles to occur, which would indicate 17.5 feet.

In Conclusion

I did think about commercial applications for SonarTape. Just because I'd like one, however, doesn't mean it has any potential. The high cost of the additional circuitry, packaging, and LCD make it either a high-priced novelty or cost-effective only in mass production. I'll stick with my prototype and wait for the next development iteration so that I can cover this subject in another four years.

One additional application that I started prototyping but discontinued as not completely germane to this article was a blind sonar sensor. Such a device (for the blind or any sightless application, such as firemen entering a smoke-filled room) would conceivably allow a sightless person to "hear" a picture of the environment by sweeping a hand-held ranging unit in front as he or she walked. Rather than a visual display, the distance measurement would be a tone whose frequency was a function of distance. My initial design consisted of continuously triggering the INIT line with a 5-Hz oscillator and applying the INIT and ECHO signals to an AND gate to produce a single pulse output whose pulse width was the elapsed time between INIT and ECHO. Next, using an integrator circuit, or even a simple RC (resistor-capacitor) combination, the pulse width is converted to a DC voltage level. The longer the pulse width, the higher the DC level.

(continued)

```
ECHO   EQU $
       TM      02H,#01       ; IS ECHO BIT ON?
       JR      Z,EXIT        ; NO, LET ANOTHER PASS OCCUR
DONE   EQU     $
       LD      31H,#0FFH     ; TURN ON DONE FLAG
       AND     TMR,#0F3H     ; TURN OFF T1 TIMER
       AND     IMR,#1FH      ; DISABLE IRQ 5 INTERRUPT
       LD      02H,#0        ; SHUT OFF INIT LINE
EXIT   EQU     $
       IRET                  ; RETURN FROM INTERRUPT
;
; END OF MACHINE-LANGUAGE ROUTINES
;
ZZZZ   EQU     $
```

(1c)

```
  RUN
32 FEET 3 INCHES
129 0.445-MS PERIODS

32 FEET 3 INCHES
129 0.445-MS PERIODS
```

Listing 2: *The Apple II versions of the programs in listing 1. The output is the same as for the Z8.*

(2a)

```
1 REM APPLE II VERSION RANGING SYSTEM
10 POKE -19293,0: REM SHUT OFF INIT LINE
30 PRINT CHR$ (4);"BLOAD RANGE.0": REM LOAD OBJECT PROGRAM
40 POKE 12328,0: REM CLEAR COUNT
50 CALL 12288: REM CALL RANGING SUBROUTINE
60 C = PEEK (12328): REM GET COUNTER VALUE
70 F = 0:I = 0:O = 0: REM CLEAR FEET, INCHES, OVERFLOW
80 IF C = 255 THEN O = 1: GOTO 120: REM SET OVERFLOW IF
   COUNT=$FF
90 F = INT (C / 4): REM CALCULATE FEET
100 I = (C - (F * 4)) * 3: REM AND INCHES
120 REM APPLICATION CODE STARTS HERE
130 IF O = 1 THEN PRINT "OVERFLOW": GOTO 40
140 PRINT F;" FEET ";I; " INCHES"
150 PRINT C;" .455-MS PERIODS": PRINT
160 GOTO 40: REM AND MAKE ANOTHER PASS
```

(2b)

```
*-------------------------------------------------------------------
* APPLE II  VERSION RANGING SYSTEM
*-------------------------------------------------------------------
*
        .OR  $3000
RANGE.EQ     *
        LDA  $C05B      * TURN ON INIT LINE
DELAY .EQ    *
        LDA  #184       * SET DELAY COUNT TO 184
LOOP  .EQ    *
        ADC  #1         * ADD 1 TO DELAY COUNTER
        NOP             * NO OPERATION FOR TIMING
        BCC  LOOP       * LOOP UNTIL CARRY
        CLC             * CLEAR CARRY FLAG
        LDA  COUNT      * PICK UP OLD COUNT
        ADC  #1         * ADD 1 TO IT
```

(continued)

```
        STA  COUNT    * AND SAVE IT
        BCC  ECHO     * IF NO WRAP, CHECK ECHO
* WRAP OF PERIOD HAS OCCURRED. SET OVERFLOW.
        LDA  #$FF     * GET A $FF
        STA  COUNT    * WRITE TO COUNTER
        JMP  EXIT     * AND LEAVE THIS ROUTINE
ECHO    .EQ  *
        LDA  $C061    * PICK UP ECHO BYTE
        AND  #$80     * TEST ECHO BIT
        BEQ  DELAY    * IF NO ECHO, DO ANOTHER LOOP
EXIT    .EQ  *
        LDA  $C05A    * SHUT OFF INIT LINE
        RTS           * RETURN TO BASIC
*------------------------------------------------------------------------
COUNT        .BS $1   * COUNTER DATA BYTE
*------------------------------------------------------------------------
*------------------------------------------------------------------------
* END OF RANGE SUBROUTINE
*------------------------------------------------------------------------
ZZZZ    .EQ  *
```

Listing 3: *To modify the Z8 program in listing (1a) for the alarm application, add the* BASIC *statements in (3a), except for the* REM *statements. To modify the Apple II program in listing (2a) for the alarm application, add the* BASIC *statements in (3b).*

(3a)

```
5 R=120:P=20                              :REM SET RANGE AND
                                           NUMBER OF PASSES
140 IFO=1THENP=20:GOTO40                  :REM RESET PASSES IF
                                           OVERFLOW
150 IF ((F*12)+I)>R THEN P=20:GOTO 40     :REM RESET PASSES IF
                                           OUTSIDE RANGE
160 P=P-1                                 :REM PASSES=PASSES-1
170 IF P>0 THEN 40                        :REM IF PASSES NOT DONE,
                                           TRY AGAIN
180 REM OBJECT WITHIN RANGE FOR NUMBER OF PASSES. ALARM
190 @2=4                                  :REM SET ALARM BIT
200 REM LOOP
210 GOTO 200                              :REM LOOP FOREVER
:
:
:
:AS BEFORE, DO NOT ENTER THE :REM STATEMENTS
```

(3b)

```
2 REM TO MODIFY THE APPLE PROGRAM FOR THE APPLICATION, ENTER
  THE FOLLOWING.
3 R = 120:P = 20: REM SET RANGE TO 10 FEET, PASSES TO 20
20 POKE -16291,0: REM SHUT OFF ALARM
80 IF O = 1 THEN P = 20: GOTO 40: REM RESET PASSES IF OVERFLOW
90 IF ((F * 12) + 1) > R THEN P = 20: GOTO 40:
   REM RESET PASSES IF OUTSIDE RANGE
100 P = P - 1: REM PASSES = PASSES -1
110 IF P > 0 THEN GOTO 40: REM IF NOT THROUGH ALL PASSES, DO
    ANOTHER
120 POKE 16292,1: REM TURN ON ALARM
130 REM LOOP HERE
140 GOTO 130
```

When ECHO goes high, the integrator output would be sampled and held (until the next ranging sample) with a sample-and-hold circuit. The output of the sample-and-hold circuit is connected to a voltage-controlled oscillator such as the XR4151 or XR2206. Short distances produce low tones; long distances result in high tones. A little bit of experience recognizing tone patterns should allow any of us to walk without seeing.

I chose not to pursue the design at this time. If any of you build a working unit, however, I'd like to know about it. Among the hundreds of letters I receive each month are some from readers who might benefit by the information.

Finally, I'm not ending this article by discussing all the possible applications for the TI ranging module. The number is so great that they are impossible to list. Now that you know the unit exists and how to attach it to a computer, perhaps you'll demonstrate some novel uses. For me, it's on to the next project.

Next Month

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Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in reprint books from BYTE Books, McGraw-Hill Book Company, POB 400, Hightstown, NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles that appeared in BYTE from September 1977 through November 1978. *Volume* II covers December 1978 through June 1980. *Volume* III covers July 1980 through December 1981. *Volume* IV covers January 1982 through June 1983.

To receive a complete list of Ciarcia's Circuit Cellar project kits, circle 100 on the reader-service inquiry card at the back of the magazine.

BY JOHN DOOLITTLE

USING A MOUSE WITH LOTUS 1-2-3

A *more comfortable tool for cursor movement*

A MOUSE COMBINES the selection capability of a light pen with the maneuverability and precision of a joystick, but it's easier to use than either. Instead of the precise finger control and position estimation required of a light pen, a mouse allows you to use more comfortable arm and wrist movements, shows you exactly where it is pointing on the screen display, and allows you to specify several options because it typically has several buttons. A joystick may be the proper tool for a maze, but a mouse is a more comfortable tool for a word processor or for hand movement across a surface.

So I bought a mouse. A Microsoft mouse. After a minimal amount of practice, I became fairly proficient with it and decided to try it with some of my other programs. But I didn't have any other programs that already supported a mouse.

At this point I thought that it might have been a bad decision to get Microsoft's mouse. I thought of the ads that say, "And you can use our mouse immediately with your old programs because it simulates keyboard input." I thought that if I'd gotten one of those I'd be able to use my other programs with the mouse.

The rest of this article offers a solution to this dilemma: a program that converts input from the Microsoft mouse to simulated keyboard input for the IBM Personal Computer (PC). You don't have to modify any Lotus code, but the program works so closely with Lotus 1-2-3 that it is actually faster to move the cursor with the mouse than with the arrow keys. Furthermore, you can easily modify the program to use it with other full-screen input programs.

The idea is straightforward. Write a small handler for mouse interrupts that converts mouse movement into arrow keys and button presses into carriage returns or function keys.

I'd originally planned a resident handler to present the same keys to all programs. I even hoped Microsoft might buy it and include it in its device driver. I had wondered why Microsoft had overlooked such an obviously useful routine, but the thought of using the mouse with my old programs dispelled my suspicions.

There are several problems with a resident handler. First, when true mouse-using programs run, they reset the mouse driver, which would destroy my pointer to the resident handler. The program would still take up storage, but it wouldn't be usable without a pointer.

Second, the programs you want to use with the mouse may use different keys to move the cursor. Some always use the arrow keys, but

 PHOTOGRAPHED BY PAUL AVIS

some use the space bar or the backspace to position the cursor over the menu area and the arrow keys to move it in the display area.

Spreadsheet column width may vary also. In the menu area, an arrow key may jump six characters with each movement, while in the display area it moves one character at a time or, in the case of a spreadsheet, some other column width. The sensitivity to mouse movement must be variable so the cursor movement on the screen appears more intuitive. And the horizontal break between the menu and the display area is not standard, so you can't preset column-width sensitivity by the placement of the cursor.

Finally, unless the program knows about the mouse, it can't synchronize the mouse's cursor with its own cursor. It might be possible for the interrupt handler to search the screen buffer for something that looks like a cursor, but that's time-consuming and error-prone. Therefore, it is probably best if you don't display the mouse cursor.

The particular program presented here has essentially three parts. The first part sets up parameters and initializes the mouse interrupt handler. The second or main part loads and executes LOTUS.COM and then returns to DOS. The third part is the mouse interrupt handler that converts mouse signals into keystrokes and inserts them into the system's keyboard buffer. The farther you move the mouse, the more characters are inserted into the buffer.

MOUS123 requires DOS 2.0 but will work with either a color or monochrome monitor. Copy the MOUS123.COM and one of the Microsoft mouse driver programs (MOUSE.COM or MOUSE.SYS) to your Lotus 1-2-3 system disk. MOUSE.COM is a Microsoft-supplied program that installs the device driver from the command prompt after booting. MOUSE.SYS accomplishes the same thing but installs the driver during the boot in the same way the IBM virtual disk driver does, via an entry in CONFIG.SYS. The two methods are equally effective, but you must choose one. Change the AUTOEXEC.BAT member to execute MOUS123 instead of LOTUS. If you use MOUSE.COM, make MOUSE the first command in AUTOEXEC.BAT. The next time you boot the Lotus 1-2-3 disk, you will be able to use the mouse to move the Lotus 1-2-3 cursor and to make menu selections.

Using the Program

When using the mouse programs the Lotus 1-2-3 screen appears the same as it always did. The only difference is that the mouse moves the cursor on the screen. Actual data entry still requires the keyboard, but you can leave the Num Lock set and use the keypad for data entry while you use the mouse for cursor movement.

MOUS123 recognizes three button presses. Pressing both buttons together flips between the menu and the display area. A generalized program can't do that because the required keystrokes to switch to and from the menu vary, a slash instead of an Esc. Different programs have different conventions. MOUS123 is customized for Lotus 1-2-3. Pressing just the left-hand button simulates the return character, <CR>, the key that Lotus 1-2-3 uses for menu selection. Pressing just the right-hand button simulates the F1 function key that Lotus 1-2-3 uses to request Help screens.

The Mous123 Program

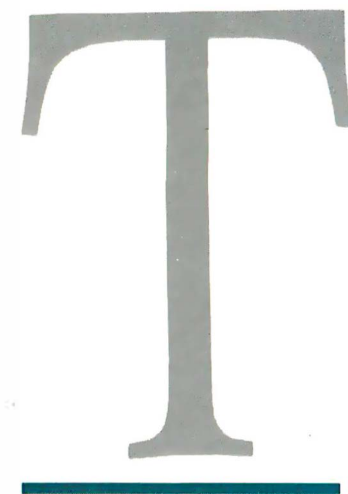
The initialization routine first checks to see whether the mouse hardware and the driver software are present. Then it sets a mask to indicate which conditions to trap and passes them along with the address of the routine (MINT) to the mouse interrupt handler (INT 33h). [*Editor's note: Whenever you find a number followed by a lowercase h in this article, the number given is in hexadecimal notation.*]

When COMMAND.COM executes a program like MOUS123, it permits all the remaining memory to be used and sets the stack pointer so high in the segment that the program uses at least 64K bytes. You must take special action to share that memory with another program, namely Lotus 1-2-3. MOUS123 first points the stack pointer much lower, calculates the segment's new upper bound and the pointer to the stack's new top (see listing 1). It then rounds the new segment boundary up to the next 16-byte paragraph and releases all storage above it (using DOS function 4Ah) making room for Lotus 1-2-3. Finally, MOUS123 sets up the parameter lists and register values that are required to load and execute LOTUS.COM (using DOS function 4Bh). That DOS 2.x function creates an entirely new environment-parameter area and a new segment prefix for 123.EXE, making it look as if COMMAND.COM had invoked it directly. When Lotus 1-2-3 completes and

(continued on page 391)

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IMPLEMENTING CRYPTOGRAPHIC ALGORITHMS ON MICROCOMPUTERS



BY CHARLES KLUEPFEL

THE JANUARY 1983 ISSUE of BYTE contained an article called "Public Key Cryptography" by John Smith. He presented a small-scale version of the RSA (Rivest-Shamir-Adleman) cryptographic algorithm to encode and decode messages. The algorithm was written in BASIC and limited to six-digit numerical "keys." At the end of his article, Smith posed the possibility of a full-scale encoding scheme for microcomputers using 100- to 200-digit keys.

The following article and accompanying programs will help you to create up to 200-digit cryptographic keys using the muMath/muSimp package, a variant of LISP distributed by SoftWARE-house. The muMath package gets around BASIC's inability to handle large numbers, letting you use numbers with as many as 611 digits. I use the Apple II ADIOS version of this package, but all versions are essentially the same.

Although I developed these programs from the bottom up, I'll present them from the top down. Along the way I'll describe the workings of the muSimp language where necessary. In several instances, I use algorithms taken directly from Donald Knuth's text *The Art of Computer Programming: Semi-Numerical Algorithms* (volume 2, second edition), rather than Smith's modifications.

First, let's review the encoding scheme. The RSA algorithm, and public-key cryptography in general, allows you to encode and broadcast a message in numerals that anyone can receive but only the originator of the key can decipher. Conversely, because only the originator can produce a certain type of scrambled message, the recipient can verify that it came from a specific person.

The source of the secrecy is the RSA algorithm's use of modular arithmetic and the originator's "private" key.

Step one is to encode a message into numbers or a series of numbers. You can use any method to do this. (Smith's article describes a method based on converting letters to their ASCII [American Standard Code for Information Interchange] equivalents.) I'll assume that the sender and receiver share this numerical code.

The RSA algorithm uses cubes and cube roots in an arithmetic environment to further encode and decode the sender's message. The algorithm raises the numerical message to the third power mod n (modulo n). In this case, n is the originator's widely publicized multidigit number, his public key.

As encoding is cubing, to decode a message you must take the cube root. This is generally impossible for a large number of digits when the arithmetic is modular. What makes decoding (finding the cube root) possible is that n, the public key, is

chosen as the product of two large prime numbers, p and q, from which another number, d, called a "private" key, is derivable. The number d is about as long as the number n. To decode (take the cube root mod n), you raise the encrypted number to the d power mod n.

The length of the number to be encoded (your message) must be more than one-third the length of the public key n, that is, larger than the cube root of n. Otherwise, the encoded message can be decoded by taking a nonmodular cube root, for example, encoding 3: 3^3 mod 100 is 27. Twenty-seven is a perfect cube already, so that $\sqrt[3]{27}$ (decoding) mod 100 is just $\sqrt[3]{27}$ or 3, the number we originally encoded. When the encoded message (3) length is longer than the cube root of the modulo n, such as in 3^3 mod 13, it's more difficult to determine the original number because 3^3 mod 13 is 1. To increase the length of any message number, just pad the message with blanks to make it large enough to decode.

The accompanying programs produce a unique n and d for each user for encoding and decoding messages converted to numbers. On the listings, note that the prompt is (?) similar to a READY or Apple's (]). The DISPLAY function, given in immediate mode, acts as a command to print the function named as its argument, similar to a LIST in BASIC.

Listing 1 shows one version of the highest level block of code, SETUP, used in selecting the keys, public (N) and private (D). You can change this section depending on how many digits you want in the respective keys. The first function, RANDOMIZE, starts the random-number generator. The remainder depends on following Knuth's algorithm for determining the keys n and d. In Knuth's algorithm there are two stages: first a prime number with n_1 digits is selected; then this is multiplied by an n_2-digit number. The next prime number (within certain restrictions) after that (having about $n_1 + n_2$ digits) is selected as the p or q value used in forming $n = pq$ and $d = (2(p-1)(q-1)+1)/3$, the public and private keys. Since we have to choose two primes, p and q, there are two assignment statements in SETUP, both referencing the function CHOOSEP. Assignment in muSimp is shown with the colon (:) rather than with either the equal sign (=) or the combination of the two (:=). The two numbers passed to CHOOSEP each time are the n_1 and n_2 referred to above. The sum of these four numbers is therefore the approximate length of each key (public and private) to be produced.

Listing 2 shows the CHOOSEP function. Recall that we invoked it with two arguments, but note that the parameter list shows eight parameters. The additional items mentioned, beyond the number used in the reference, merely serve to declare these as local variables. Also, the two parameters that are passed are passed by value; that is, any changes made to N or $N2$ within CHOOSEP in no way affect any variables outside of CHOOSEP, in particular, no variable called N or $N2$, nor whatever variable may be put into the argument list of the invocation.

Knuth describes a choice of p and q as follows:

> Start with a truly random number, p_0, between 10^{80}, and 10^{81}. Search for the first prime number p_1 greater than p_0...[a "probable prime" after 50 iterations of the algorithm to be described below].... Then choose another truly random number p_2[not necessarily prime, despite its letter] between, say, 10^{39}, and 10^{40}. Search for the first prime number p of the form $kp_1 + 1$ where $k >= p_2$, k is even, and $k \equiv p_1$ (modulo 3).... The prime p will be about 120 digits long; a similar construction can be used to find a prime q about 130 digits long. For extra security, it is probably advisable to check that neither $p+1$ nor $q+1$ consists entirely of rather small prime factors.... The product $N=pq$, whose order of magnitude will be about

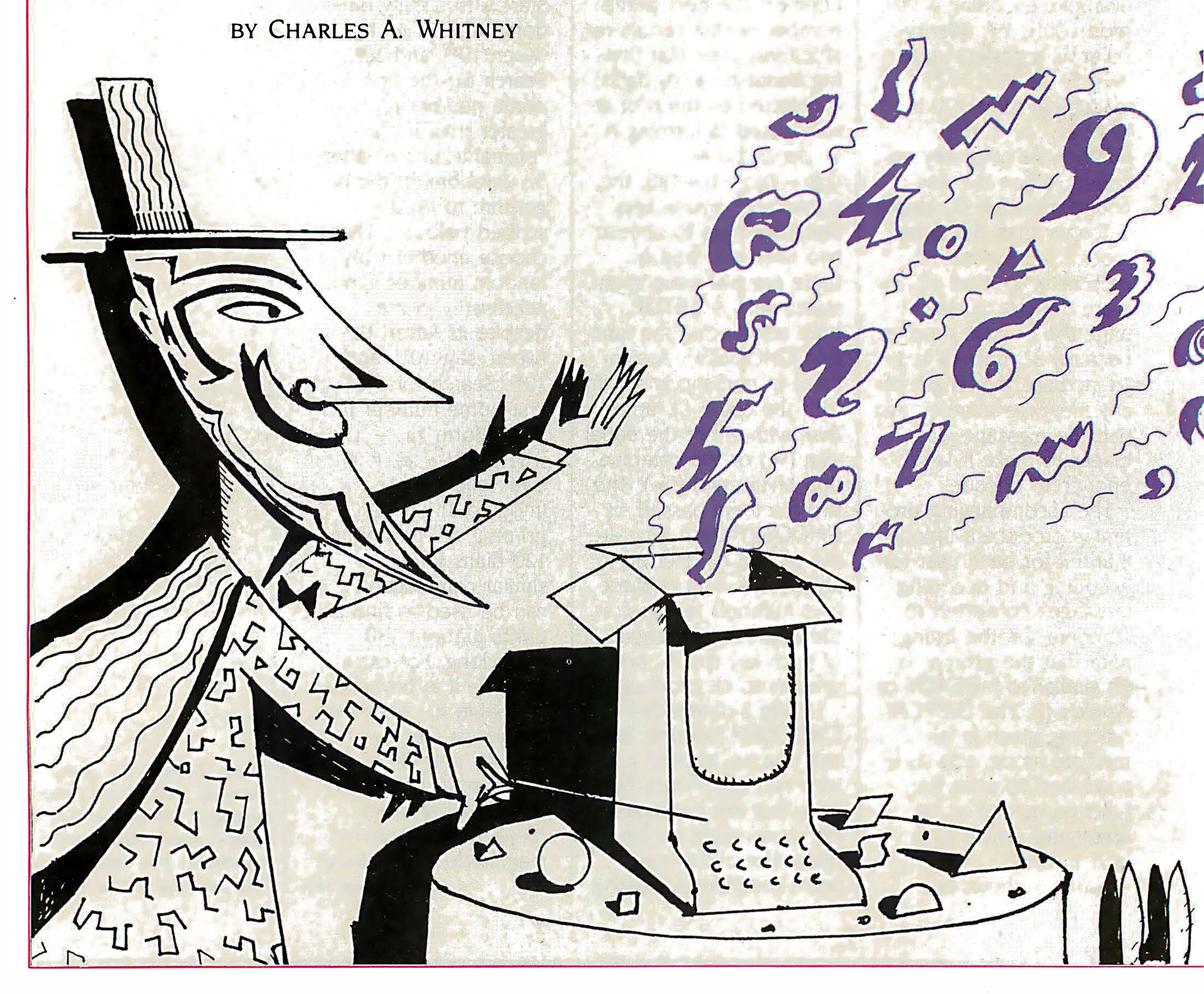
(continued on page 395)

Create up to 200-digit keys

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GENERATING AND TESTING PSEUDORANDOM NUMBERS

BY CHARLES A. WHITNEY



ILLUSTRATED BY MACIEK ALBRECHT

Analyze haphazard occurrences with linear congruential generators

IF A DRUNKARD starts from a lamppost and randomly staggers away, how far will he have progressed in one thousand steps? Expressed in varying forms, the "drunkard's walk" has become a staple of mathematical physics. How far will an impurity atom migrate in a crystal lattice? How many steps will be required for a photon to emerge from a foggy atmosphere? They are all the same question, and they can be treated with "Monte Carlo" calculations. These calculations are finding increasing applications in business, as well. For example, they provide an analysis of how best to serve customers arriving haphazardly at a counter. Carrying out such calculations depends on being able to imitate randomly generated numbers, and this is not easy. It has been said that more time has been spent generating and testing random numbers than using them.

You can find numerical examples of random series all around you. The final integers in a list of telephone numbers gives a good random series in the range 0 to 9. The face values of cards drawn from a well-shuffled deck and the final digits in license-plate numbers on passing cars are usually quite reliable. (But the first digits of such numbers are often far from random.)

The property that defines a randomly generated series is that each number is independent of all earlier numbers. In other words, the process that generates the random series has no memory. Therefore, even if you know all the previous numbers, you cannot predict with certainty the next one. (And if you have been losing at a truly random game, you have no reason to think you will start winning.) That's why flipping a coin is such a good method of generating a random series of zeros and ones. Each flip is entirely independent of the others.

Before going further, I should try to clarify a point of language that can lead to confusion. Strictly speaking, no such thing as a random number exists—only a random process. The number 12345 is neither less nor more random than the number 32719. In a series of 100,000 randomly generated numbers, both of these would have the same chance of occurring. The idea that 12345 is less random comes from comparing it with a simple pattern of ascending digits. Thus, instead of saying you are trying to produce random numbers, you should say you are trying to construct a method that will produce a series of numbers that imitates the results of a random process. But for the purpose of this article, I will use the word "random" more loosely to refer to a random sequence or a random number, without worrying about the niceties. If a sequence looks like it was generated by a random process, I will call it random and will put off the question of how to judge appearances until I discuss methods of testing random-number generators.

To carry out a Monte Carlo calculation, you need to work with random numbers inside a computer. But you are faced with the fact that a purely digital computer is a deterministic machine—except on its "off" days—and such a device cannot truly generate a random process. You have to be satisfied with deterministic algorithms that imitate random processes. You can thus generate "pseudorandom" numbers with some of the earmarks of randomness. Naturally, some random-number generators work better than others, and you must be wary.

Linear Congruential Generators

Mathematicians have suggested many methods for generating pseudorandom numbers with a digital computer. Happily, the most common and powerful one involves simple arithmetic. This method is the linear congruential generator, or LCG for short. An LCG produces a series of numbers, I_i, where the subscript "i" indicates the location of the number; $i = 1$ indicates the first number, $i = 3$ is the third, and so on. Since each successive term, I_{i+1}, is computed from its predecessor, you can see right away that this series is not truly random because it has memory. That is why the LCG is called a "pseudorandom"-number generator.

To understand the LCG, look at the following linear expression:

$$I_{i+1} = aI_i + c, \ (a > 0, \ c \geq 0)$$

This expression multiplies each number by the factor a and then adds c to find the next member. It produces an ascending series of numbers whose differences are given by the expression

$$I_{i+1} - I_i = (a-1)I_i + c$$

We call the process "mapping" because it carries the integer, I_i to I_{i+1}, from one point to the next in a one-dimensional space, as shown in figure 1.

Suppose $a = 2$ and $c = 1$; then you have 1, 3, 7, 15. As it stands, this series doesn't look random. To create a series that looks random, you need a method of scrambling the output, perhaps by cutting off the upward run. One way to achieve this appearance is to imagine you've subdivided the number line representing the I-space into segments of length m. If you make the multiplier, a, in the LCG suf-

(continued on page 442)

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BY GARY F. SIMONS

DATA ABSTRACTION

A BASIC IMPLEMENTATION FOR PROBLEM SOLVING

Editor's note: For more information and background reading on data abstraction, see the article by Niklaus Wirth in the August issue, "History and Goals of Modula-2."

PROGRAMMERS, AND INDEED problem solvers in general, have two basic strategies for attacking new problems: decomposition and abstraction. These strategies offer two different ways of solving a complex problem by simplifying it in some way. Decomposition is the strategy embodied by the time-honored Machiavellian dictum to "divide and conquer"—solving large problems by dividing them into simpler, smaller ones that can be solved independently. Abstraction is the strategy of ignoring certain details about the original problem so as to transform it into a simpler and more general one.

For example, consider the problem of computing the sum of the squares of two numbers, 3 and 4 (that is, compute $3^2 + 4^2$). We first simplify the problem by decomposing it into a sequence of three simpler problems: (1) compute the square of 3, (2) compute the square of 4, and (3) add the two results together. We assume that the final step of addition is sufficiently fundamental that we need not consider it further. However, the first two subproblems can be restated in more simple terms. "Compute the square of 3" means the same as "multiply 3 by 3," and "compute the square of 4" means the same as "multiply 4 by 4."

We may now apply the principle of abstraction to simplify the problem further. We see that there is something essentially the same about computing the square of 3 and computing the square of 4. By abstracting away the particular details of the 3 versus the 4, both subproblems can be solved by a single more general solution, namely, that of computing the square of *n*, where *n* can represent any number.

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INFORMATION HIDING AND ABSTRACT DATA TYPES

The essential design methodology for data abstraction is known as *information hiding*. The approach was first proposed by D. L. Parnas in 1972 (see reference 4). He proposed that the behavior of software modules be specified completely in terms of their external effects. Such a module hides a secret, namely, the representation of the data object that the module manages. To the outside user, the module provides a set of access functions that are used to create, alter, or observe instances of the abstract data object. There is no way for anyone or anything but the implementation of the module itself to access the objects, other than through those access functions.

The type of module that Parnas first described has come to be known as an abstract data type. It is abstract because the details of the concrete representation of the data type are unknown to the user. It has also been called an *encapsulated* data type, since the details of implementation are locked away from the user inside a capsule. The functions that access an abstract data type are now commonly referred to as its *operations*.

An abstract data type, therefore, presents itself to the user not as a data structure, but as a collection of procedural abstractions. These are the operations that allow one to create, observe, or alter objects of the abstract type. The task of implementing an abstract data type then consists of determining a concrete representation for objects of the type and writing the procedural abstractions that operate on objects thus represented.

THE INFORMAL SPECIFICATION OF ABSTRACT DATA TYPES

Two methods for specifying the behavior of abstract data types have emerged. The first is an informal approach that uses prose statements to describe the effect of each of the operations of the data type. The second is a formal approach that uses algebraic statements that are precise and unambiguous. Both approaches are described in turn.

Barbara Liskov gives a complete example of the informal method in her paper "Modular Program Construc-

tion Using Abstraction." (See reference 3.) In Liskov's informal approach, the specification of a data abstraction has three parts: a header that names the data abstraction and its operations; a brief description of the data abstraction as a whole; and a specification for each of the operations. Each of the operations is a procedural abstraction. The specification of a procedural abstraction may have four parts: a header; a **modifies** line; a **requires** line; and an **effect** line. The header defines how the procedure interfaces with the outside world, that is, its name, the order and types of its inputs and outputs, and the error conditions it signals. The **modifies** line defines which of the inputs may be modified by the procedure. The **requires** line defines any assumptions that are made about the calling environment. The **effect** line describes what the operation is intended to do. Figure 1 gives some sample specifications for procedural abstractions based on Liskov's approach.

We may now illustrate the specification of a data abstraction. Figure 2 gives a sample specification of a data type called **intset** (set of positive integers). Note the three parts of the specification: the header that names the data type and lists its operations; a brief description of the data type as a whole; and the specifications for each of the operations.

The Formal Specification of Data Abstractions

The formal approach to specifying data abstractions defines an abstract

(continued on page 414)

```
divide (x,y:real) returns real signals divide-by-zero
  effect if y = O then signals divide-by-zero
    else returns x/y

sort (x:array[int])
  modifies x
  effect sorts the elements of x in ascending order

search (x:array[int], y:int) returns int signals no-match
  requires x is sorted in ascending order
  effect returns i such that x [i] = y;
    signals no-match if no such i is found
```

Figure 1: *Sample specifications of procedural abstractions (after Liskov).*

```
intset is create, insert, remove, isempty, ismember

  Intsets are sets of positive integers; the maximum size of an intset is 2^16 - 1
members. Intsets are either created empty (using create) or made from other intsets
with a new member added (using insert) or removed (using remove). Isempty tests
whether an intset has any members; ismember tests whether a given integer is a
member of an intset.

create ( ) returns intset
  effect returns an empty intset

insert (s:intset, x:int) returns intset signals no-room
  effect if the size of s union {x} is less than or
           equal to the maximum size,
         then returns s union {x},
         else signals no-room

remove (s:intset, x:int) returns intset
  effect returns s minus x

isempty (s:intset) returns Boolean
  effect returns true if s has no members

ismember (s:intset, x:int) returns Boolean
  effect returns true if x is a member of s
```

Figure 2: *Sample specifications of data abstraction (after Liskov).*

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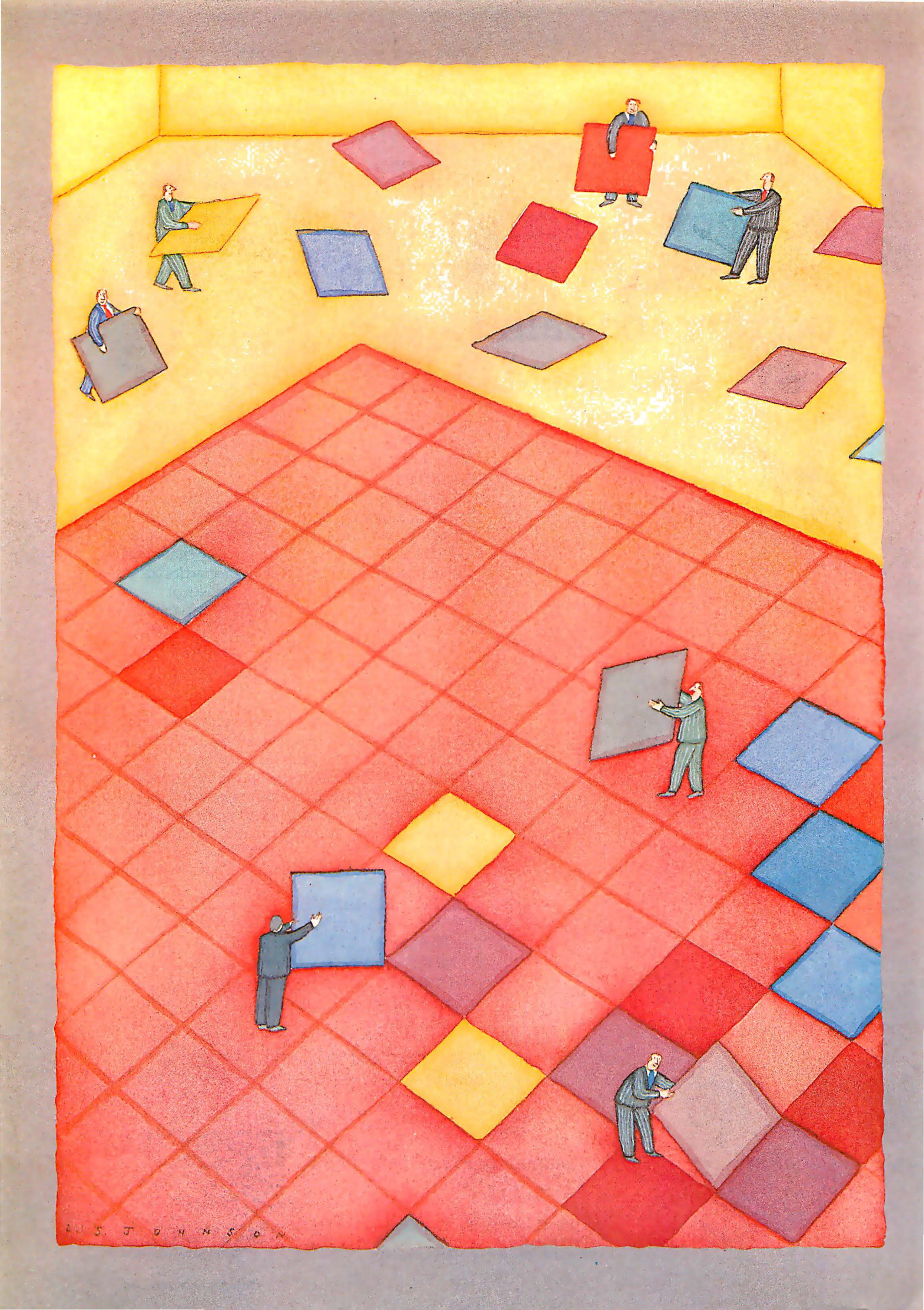


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Databases

DATABASES CONTINUE TO PLAY a large part in the development and acceptance of microcomputers. Just as the VisiCalc spreadsheet program shared a symbiotic relationship with the Apple II so that each bolstered the other, databases are a force for change in microcomputer technology and microcomputer technology is a force for change in database capability. That's why this month's theme articles discuss not only database software but hardware for databases.

Some of the terms you'll come across in these theme articles may be unfamiliar to you, so I've explained them in "Database Types." If you don't know a thing about databases, read this article first.

Ezra Shapiro, our West Coast bureau chief, tells about text, or free-form, database programs in his article "Text Databases." Text databases are hybrids: half word processor and half traditional database-management program. These programs should prove useful in organizing note taking and writing in general.

"The DayFlo Architecture" is a description of the DayFlo free-format, text-database program. This article isn't a review of the software but rather a look at the principles behind the software's operation by two DayFlo employees, Robert W. Atkins and Walter L. Mazur.

Microcomputer databases are fast, but they can't hold everything we need to know. For very large amounts of data, we turn to mainframe databases accessed via telephone lines. The bad news is that these "on-line" databases are expensive. The good news is that Matthew Lesko, author of *Information USA*, tells us how we can keep costs down and, in some cases, eliminate them altogether in "Low-Cost On-Line Databases."

Returning to microcomputer databases, we have Rick Cook and John Brandon's article "The Pick Operating System, Part 1: Information Management," which talks about an unusual development in database software—an operating system that contains a relational database manager.

Large microcomputer databases need lots of storage space, and that means hard disks. Roy M. Matney's article "Adding a Hard Disk" discusses latching a hard disk onto an IBM Personal Computer.

Even hard disks have their limits. As microcomputer databases are expected to hold larger databases, we'll need storage devices with greater capacities. In the future, large databases may mean optical disks, which will be able to hold 10 to 20 megabytes on a 2-inch disk. Edward S. Rothchild, publisher of *Optical Memory News*, discusses optical disks in "Optical Memory: Data Storage by Laser."

We cap this month's theme section with a catalog of databases by George Bond, our managing editor of User News. While not an exhaustive catalog, it is representative.

—*Rich Krajewski, Technical Editor*

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DATABASE TYPES

BY RICH KRAJEWSKI

A brief look at different ways of managing information

IN RESEARCHING DATABASES, I came upon the trap that no doubt many of you run into when seeking information—hard-to-decipher technical articles. Even the technically sophisticated readers of BYTE, I am sure, have had difficulty understanding some of the esoteric notions behind databases. I hope this article will make the subject clearer for you.

Six overlapping categories are commonly used in describing database programs: file-management system, relational, hierarchical, network, free format, and multiuser.

FILE-MANAGEMENT SYSTEM

A file-management system lets you save and retrieve records, made up of *fields*, into a file. An example of a record is:

Name	Type	Size
BYTE	computer	big

Name, Type, and Size are the names of the fields; BYTE, computer, and big are the values of the fields that make up the record. A record such as this one might go into a file called Magazines. The limitation of the file-management system is that it will not combine information in one file with information in another file. In other words, a file-management system won't let you combine the record

Name	Circulation
BYTE	425,000

from the Circulation file with the record from the Magazines file. (Some file-management systems use more than one file, which you may combine, but the files always have the same field structures; though there are several files, there is only one record type.) In this respect, a file-management system is analogous to an index card file. However, while you may search a card file by only one field (such as company name), you can search a file-management system by any of the fields in the record; for instance, by Type as well as by Name.

RELATIONAL DATABASE

A relational database is like a file-management system in that it is also made up of records, which in turn are made up of fields. It differs in that it can combine records from different files as long as the records in the different files have one field in common. Under this system you can, theoretically, combine records using a common field from an unlimited number of files with commands such as PROJECT and JOIN. PROJECT creates subset records from existing records, such as

Name	City
BYTE	Peterborough

from

Name	Street	City
BYTE	70 Main	Peterborough

The JOIN command combines records into new records, such as

Name	Editor	Page Size
BYTE	J. Comma	8 by 11 inches

from

Name	Editor
BYTE	J. Comma

and

Name	Page Size
BYTE	8 by 11 inches

The relational database gets its name from the *relation*, which is a table

(continued)

Rich Krajewski is a technical editor at BYTE. *He can be contacted at* POB 372, Hancock, NH 03449.

of data in which every row is unique. Figure 1 is an example of a relation. Notice that the relational table looks exactly like a set of records from a file-management system. The records or rows in a relation are called *tuples*. The fields or columns are called *attributes, predicates*, or *classes*.

The beauty of relational systems is that, supposedly, you can enter data without too much regard for how you are going to use it; that is, you don't have to know how records will be combined when you enter the data, as you do when you use a file-management database. However, if you don't plan how you're going to use data and input it according to that plan, you're going to spend some time getting the information out as the database program searches through your database files, makes the proper combinations, and records the results. If you knew ahead of time how you wanted your information served, you could have recorded it that way in a single file and saved yourself a bunch of time when you retrieved it.

Hierarchical Database

The hierarchical database is made up of records, as is the relational database, except that the records in a hierarchical database do not have to be broken up into fields. The records can look like relational records with several fields per record, like a word-processor file, or like a one-dimensional array of data items. They can look like anything you want because the hierarchical system doesn't look at the contents of a record the way a relational system does. In a relational system, the connections, or "hooks," between files depend on the data itself. For instance, although two files (or record sets) may have a common field, you don't join the files if the data in the two common fields is not alike. In the JOIN example I gave earlier, you couldn't join the two record sets by the common field Name if the item BYTE were not listed in both record sets under Name.

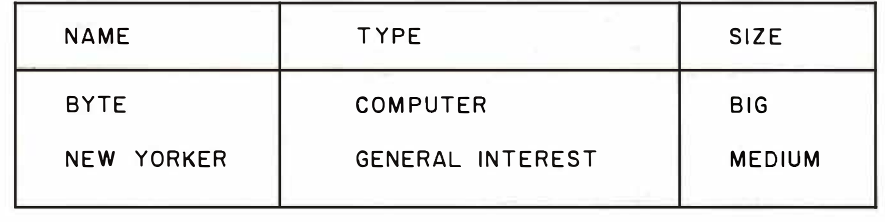
In a hierarchical system, connections between files are fixed for the life of the database. File A is always linked to File B regardless of contents.

In a hierarchical system, however, the connections between files don't depend on the data in the files. The connections are defined at the start and are fixed for the life of the database. In this system, file A is always linked to file B no matter what the contents of those two files are. And, naturally enough, the connection between record types is hierarchical.

These connections are called the *structure* of the data, and a diagram of them looks like an upside-down tree. Figure 2 shows the data structure of a hierarchical database. The file at the top is called the parent or owner file, while the files at the bottom are called the child or member files. The identifying characteristic of this system is the one-to-many connection between the owner and the member files. In other words, the member files have only one owner file. The hierarchical directory system of PC-DOS 2.0 is an example of this. Under PC-DOS 2.0, you can create subdirectories; when you call a directory such as User, it automatically comes up with several subdirectories, such as User1 and User2. Within those subdirectories will be either more subdirectories or files with data in them, but each of the subdirectories has only one owner directory. Another example of this system is the table of contents in a book. The table itself is the owner set, and the chapters that the table directs you to are the member sets.

In a hierarchical database, a search

(continued)



NAME	TYPE	SIZE
BYTE	COMPUTER	BIG
NEW YORKER	GENERAL INTEREST	MEDIUM

Figure 1: *An example of a relation. The rows are called tuples and the columns are called attributes.*

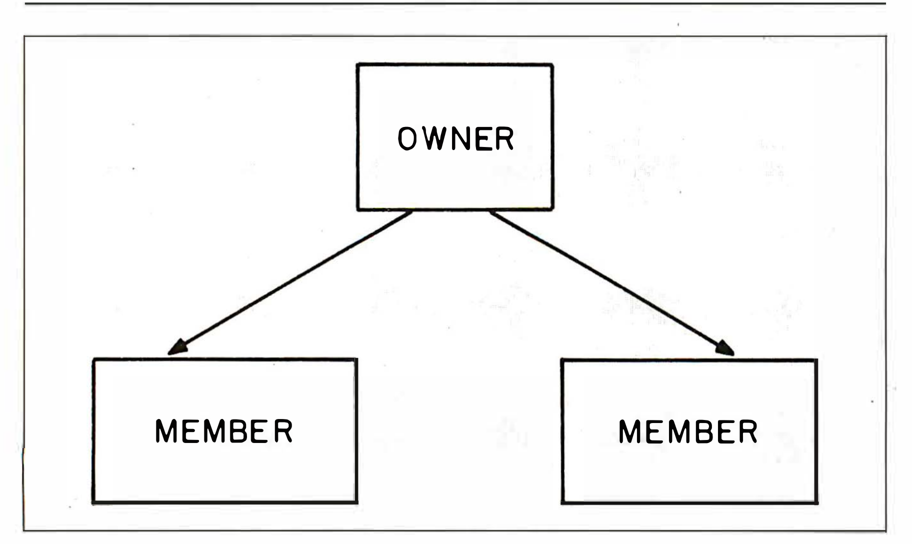


Figure 2: *The structure of a simple hierarchical database.*



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of owner files can lead you to member files and vice versa. In good systems, any update of the records in an owner file automatically updates the records in the member files.

Network Database

The network database is like a hierarchical database but with one modification—you can relate any record types or files with any other record types or files; that is, the data structure is many-to-many instead of one-to-many. A hierarchical database structure is a degenerate case of a network structure. Again, you must do the relation in advance. This is more restrictive than the relational database, but a program will run faster if you define the data structure in advance.

Figure 3 shows a simple network database structure. Notice that there can be many owner files for a single member file. A book contains a network database in the form of chapter cross-references, such as "see chapter 7 for more on fiber-optic modems."

An interesting thing about these database types is that they are just models. They are somewhat arbitrary in their definition. In fact, I've seen several varying definitions of data models and structures. Definitions are further clouded by the "procedural languages" included with some database programs. These languages enable you to, for example, define a network structure in a relational database. What counts more than these definitions is your application for data and how well a program meets the application, regardless of whether the program calls itself relational, hierarchical, or whatever.

Free-Format Database

Another type of database is the free-format database, which lets you enter information in any format you want—text, tables, or numbers—and retrieve it by means of keywords that you use to tag the information. For instance, you could write a paragraph about one of your business contacts and give it the keywords "contact" and "Moe Shmoe." This way you could retrieve the paragraph by asking the database for information about Moe Shmoe, contacts, or both. A book is a free-format database because it may be searched with keywords in the index. Some file-management programs use a free-format structure.

You could consider free-format databases to be relational if you stretch things a bit. You could say that the paragraphs and keywords you enter are in fact records consisting of the fields Paragraph and Keyword. The Keyword field would be the field by which you search the database. You could mimic a free-format database with a relational one by following this procedure.

Multiuser Databases

A multiuser database may have any of the database structures already discussed. Its defining feature is that it lets several people access a database at the same time. However, only one person ought to be able to change a record at any one time—other users should be either "locked

(continued)

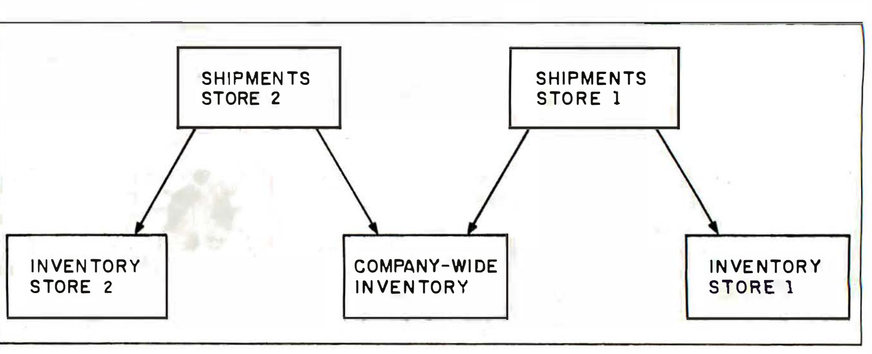


Figure 3: *The structure of a simple network database.*

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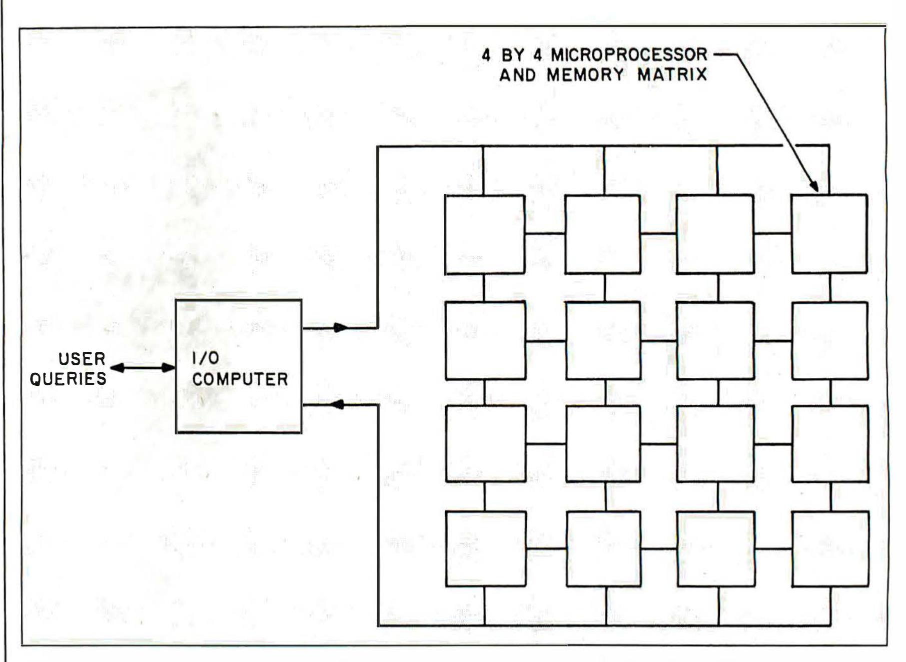


Figure 4: *A diagram of a parallel-processing database machine. The query is prepared by the I/O computer for the computer matrix, where individual parts of the query are processed separately and simultaneously.*

out" of the record entirely or admitted on a read-only basis. With large databases in corporate environments, this type of database will be a necessity.

Database Machines

Because some database systems are so input/output bound, database machines have been built to streamline the retrieval and processing of data. Figure 4 shows a model of a special type of database machine based on parallel processing. Parallel processors contain microprocessors that work together on different pieces of a problem, in this case a database query. The query is handled by different processors containing the right information, and the results are compiled and presented much faster than if a single processor had retrieved the data from a traditional mass-storage device. The speed difference is noticed only when the query involves information from several different sets or files. If the query asks for something as simple as a list of addresses, any ordinary microcomputer would work just as fast. ■

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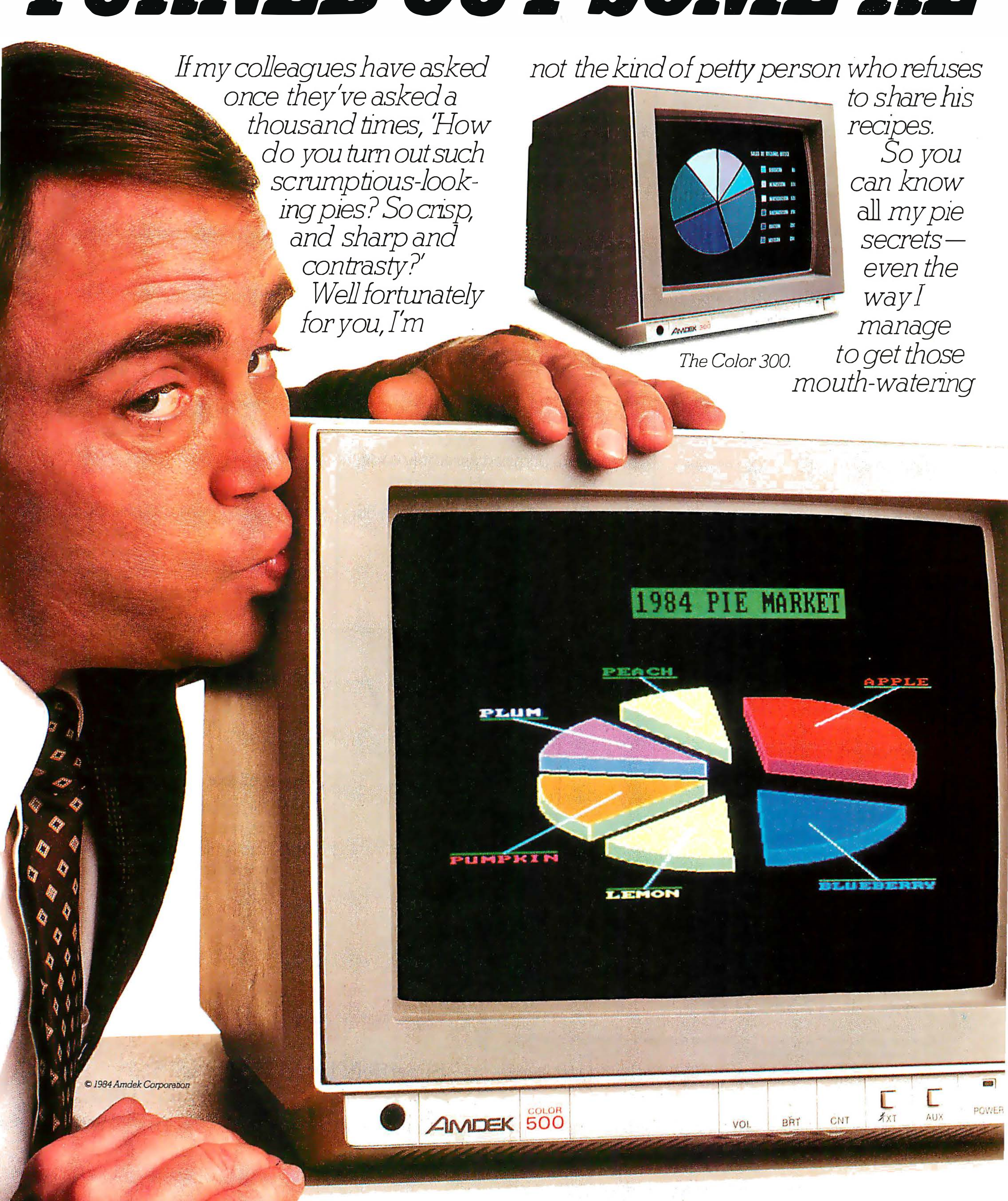
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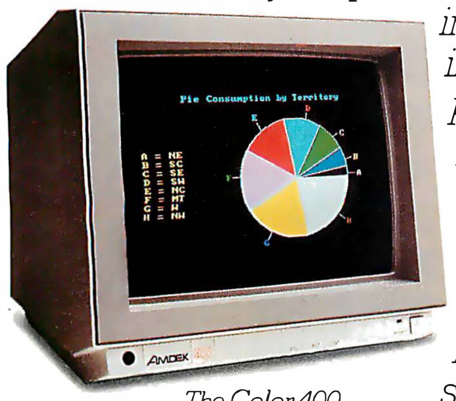


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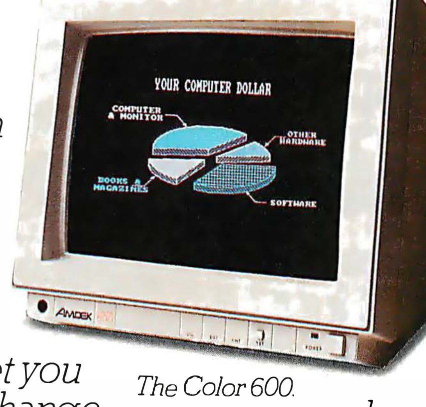
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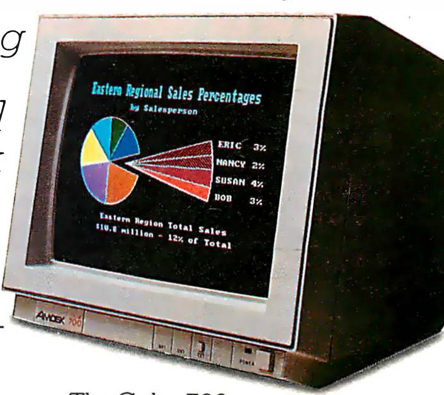


The Color 600.

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212A Modem Comparison Chart*

STANDARD FEATURES	PRO	HAYES STACK	NOVATION SMARTCAT+	ANCHOR 1200	US ROBOTICS PASSWORD
300/1200 Baud (212A)	✓	✓	✓	✓	✓
Intelligent Microprocessor	✓	✓	✓	✓	✓
Tone and Pulse Dialing	✓	✓	✓	✓	✓
Hayes Command Compatible (Works with Smartcom™)	✓	✓	✓	✓	
Additional telephone jack with exclusion switching	✓				
Analog loop back self test	✓	✓	✓		
Self Test at Power Up	✓		✓		
Call Progress Detection (Busy, Dial Tones, Trunk Busy, etc.)	✓		✓		
Speaker and External Volume Control	✓	✓	✓		
Full Complement of Status Lights	✓	✓			
8 Switch Selectable power-up defaults	✓	✓			
Adaptive Dialing	✓		✓		
Auto Redial on Busy	✓		✓		
Ergonomically designed easy to read front display panel	✓				
Internal Stand-Alone Power Supply	✓				
Built in Real Time Clock/Calendar	✓				
Help Command	✓				
300 baud connect while maintaining 1200 baud RS-232 link	✓				
EXPANDABLE OPTIONS					
Automatic Receiver Buffer	✓				
Automatic Transmit Buffer	✓				
On-board Personal/Business Directory	✓				
Buffer, Expandable to 64K	✓				
Auto Logon Macros	✓				
Auto message transmission to groups of numbers	✓				
Records call duration	✓				
12-character Alphanumeric Display	✓				

*Comparison made by Prometheus on the basis of the best information available to Prometheus at time of printing.



TEXT DATABASES

BY EZRA SHAPIRO

Integrating database and editing functions simplifies the creative process

ASSEMBLING A REPORT from a large collection of data—even if that data is entirely textual—can be tricky business. If you use a traditional word-processing program to store individual elements as you develop your materials, you'll wind up with a group of separate files that have to be pulled into one document for the final edit (see figure 1). Depending on the number of files, you might be facing a lengthy, repetitive series of maneuvers to read each element into your report, and that's before you start polishing, rearranging, and formatting the output. And if you are trying to gather your report from a large universe of text files, you'll have a tough time making sure you get everything (unless you have a photographic memory and an effective system for naming each file). The larger the collection of files, the more difficult it is to remember what's what.

A second approach involves using a database management program to store and catalog your information. Each chunk of text is labeled with a few keywords, and retrieving the appropriate data becomes a snap (see figure 2). However, most database software is designed merely to manipulate individual records, not to gather text into a document that can be edited. You have to output your text blocks somehow and then work on them with a word processor.

Neither solution is particularly comfortable. A pure word processor lacks sophisticated data-retrieval mechanisms, and a database manager lacks the editing facilities you need.

In recent months there's been an explosive growth of software products designed to solve this dilemma. These new products are ambiguously referred to as "idea processors" or "text database management systems." These programs are, for the most part, blends of text editors and data-retrieval shortcuts that let you rapidly locate text fragments and incorporate those fragments into longer documents.

The integration of text editing and text management, in an effort to provide software tools that enhance human creativity, has resulted in programs that are widely divergent in guiding philosophy. (This is one of the most hotly debated areas of software design.) Should software lead you to a more productive method of working? Or should it let you reproduce, as closely as possible, your current work habits (which may be extremely disorganized and downright sloppy)?

The models that follow are generic; they are not exact descriptions of specific programs on the market today, though a number of products come close to fitting some of these descriptions. Some of the models are purely theoretical. The best design for an editor/database might depend on personal taste, might never exist, or might require years of study and development.

OUTLINE PROCESSORS

One answer to the question of how to provide more effective text management is the outline processor, which represents a kind of text database and is certainly a major step beyond word processing. Outline processors enable you to organize material in the form of an indented outline (see figure 3). You construct a skeleton of

(continued)

Ezra Shapiro is bureau chief at BYTE's West Coast bureau. He can be reached at McGraw-Hill, 425 Battery St., San Francisco, CA 94111.

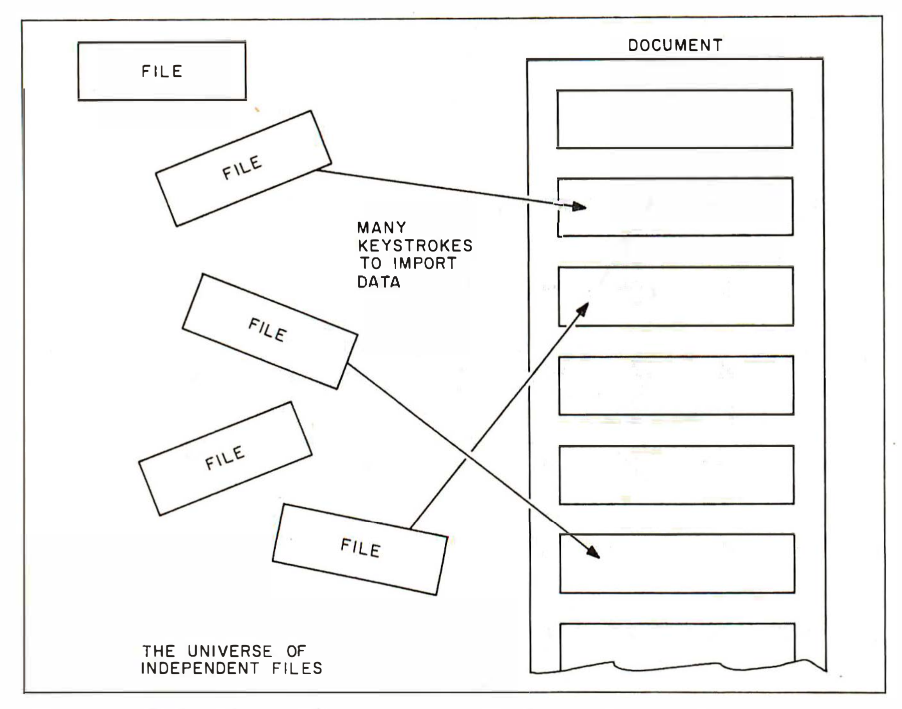


Figure 1: *The "flat text" model, which represents data as prepared by a word-processing program. Individual blocks of text are arranged one after another as entered. New blocks can be pulled in from outside the editor, but you must remember which external file contains the needed material.*

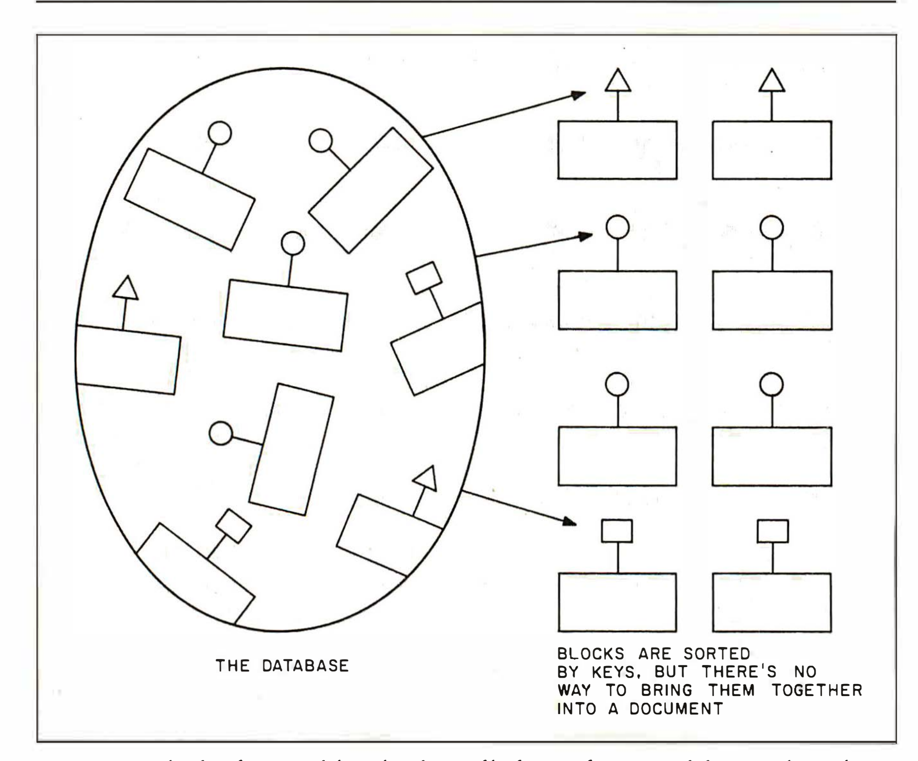


Figure 2: *The database model. Related text blocks can be retrieved from within a large library of randomly entered data, but there are no facilities for molding the fragments into a coherent document. Final editing must still be done with a text processor.*

Outline processors impose a structure on the data-entry process, which may inhibit spontaneity.

levels of topics and subtopics, any of which can be expanded to incorporate manageable chunks of text. You have the option of viewing your report as a full document or "collapsing" the view to show just the headings of each subsection. This collapsing feature lets you shrink your report to a size that's easy to comprehend at a glance. While your text remains hidden from the display, the program keeps track of it; large sections of text can be moved around within the document simply by moving a heading within the outline.

If you begin collecting your original notes with an outline processor, you can easily keep your data under control. Because most outline processors have the capability to read external files as sections under headings in the outline, you can import data from other sources, such as traditional word processors or database managers.

It is also possible to stretch the outline out on its side so it resembles an upside-down tree standing on its branches instead of on its trunk (see figure 4). This way, subsidiary topics on the same level of indentation are seen as equally weighted options and are not unintentionally ranked by the natural downward flow of an outline.

However the views are constructed, outline processors do impose a structure on the data-entry process, which may inhibit spontaneity. An outline is necessarily hierarchical in nature, with one item following another, and reorganization can be cumbersome. Random note-taking is discouraged by the system, and if you haven't developed a clear picture of the expected final report, you might find it tough to position an idea that seems appro-

priate to the topic but doesn't yet fit into the framework.

Although outline processors can expand and collapse the view of text within a document, they are essentially document-oriented in both size and function; that is, they are not designed to handle large amounts of data that require heavy sorting and weeding. An outline processor may be ideal for one report at a time, but it is not a good tool for managing a large bank of data.

Nonhierarchical Databases

The simplest form of text manager consists of an editor with two modes of operation, "record" mode and "document" mode. In record mode, the program creates records that are stored in a database. The least complex of these programs uses short records that are identified by a limited number of keywords. In document mode, the program functions basically as a word processor handling longer reports. Editing commands are the same in each mode, but record mode has an additional set for the filing of individual records; document mode lets you locate records by keyword and read them into your report for editing.

The free-form text database is a far less structured model (see figure 5). Any block of text created by the editor can be assigned one or more identifying keywords and stored in a database. A command toggle lets you title parts of your text, or flag words within the text, as keywords. A record can be called up either by keyword or by searching for a string of characters contained within the block. (If the database has grown large, a string search through every character stored in the database would not be a good idea.) Obviously, the editor has to have some kind of intermediate buffer in case a given keyword or string produces a whole bunch of text fragments. The editor can file individually any blocks it creates, and the database can index a whole group of text blocks to a single keyword so that an entire document can be reassembled from its components. There is no need to differentiate between a record and a document; the free-form system is essentially modeless.

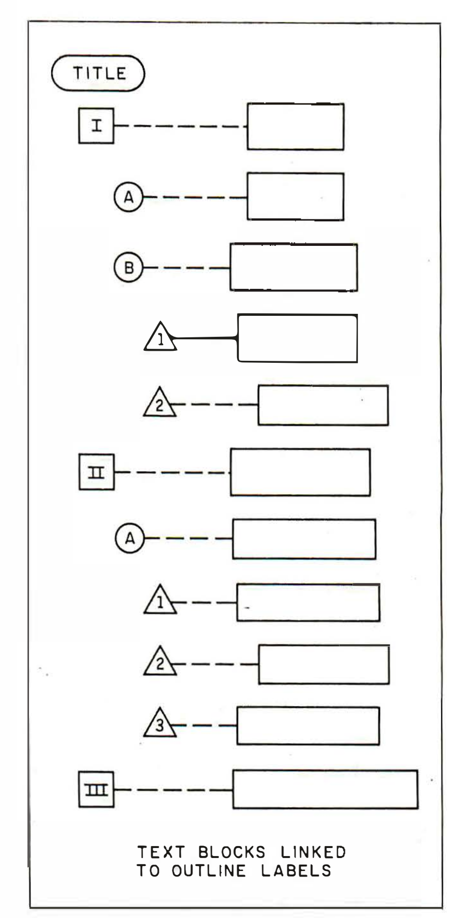


Figure 3: *The outline model. This is indeed a kind of database because it organizes blocks by keeping track of block labels (or headings). However, the outline framework imposes a rigid structure on the creative process and might be helpful only because it can show a schematic view of a project.*

The editor is the only visible environment; moving data to and from the surrounding database can be accomplished with short commands from within the editor. The only exception to this rule is a program that lets you work on several files at the same time, in which case there is an intermediate state in which you can get an overview of the available documents.

The flexibility of this sort of program should be clear. You need not be

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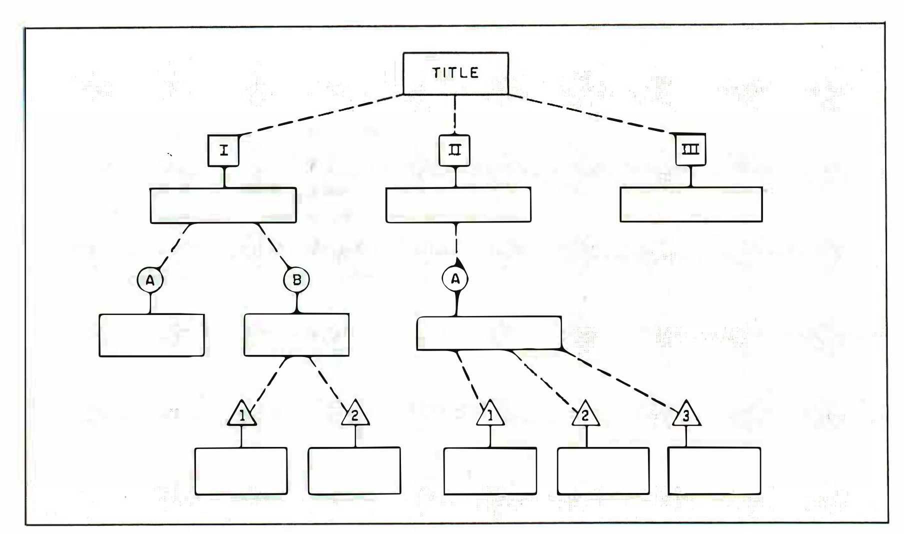


Figure 4: *The tree model. The outline in figure 3 can be tilted on its side, providing a series of alternatives on each level. This method of viewing the outline places less emphasis on the chronological order in which items were entered, but it is still essentially hierarchical.*

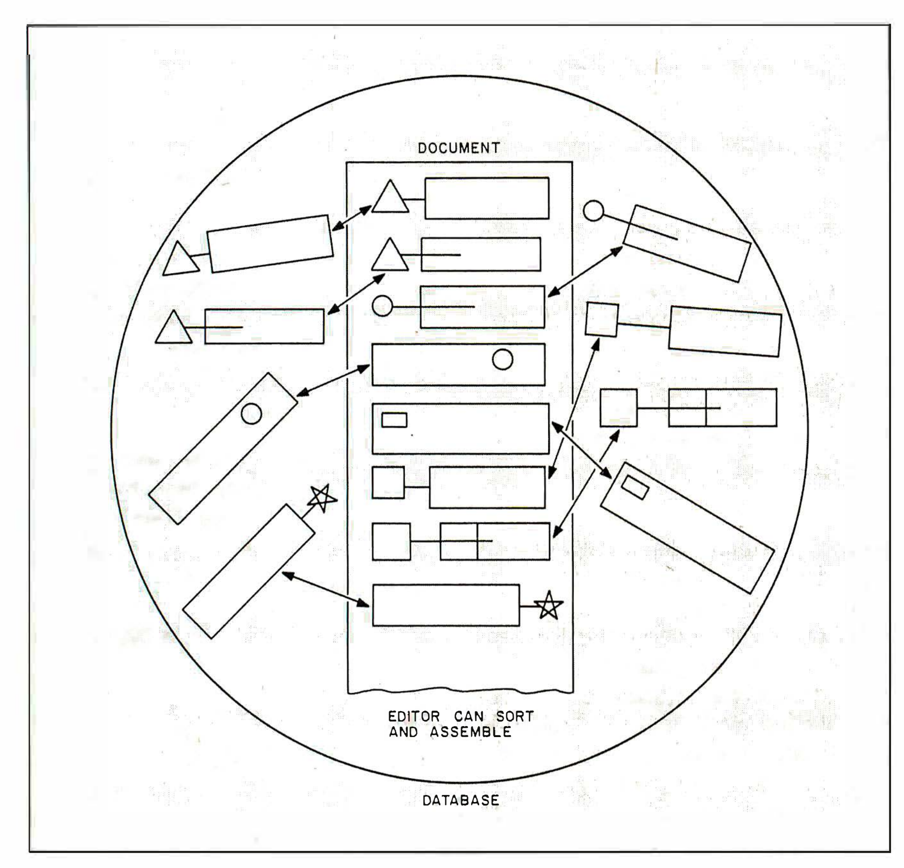


Figure 5: *The free-form text database model. Text developed with the editor is stored in a large database and indexed by keywords. The editor itself contains database search commands that can be used to pull up all fragments relating to the current topic, either by keyword or by string search. The editor can also store text in the database for later retrieval. This system is inherently nonhierarchical.*

The beauty of text database systems lies in how they free you from thinking of computers as merely a way to reproduce paper processes in an electronic medium.

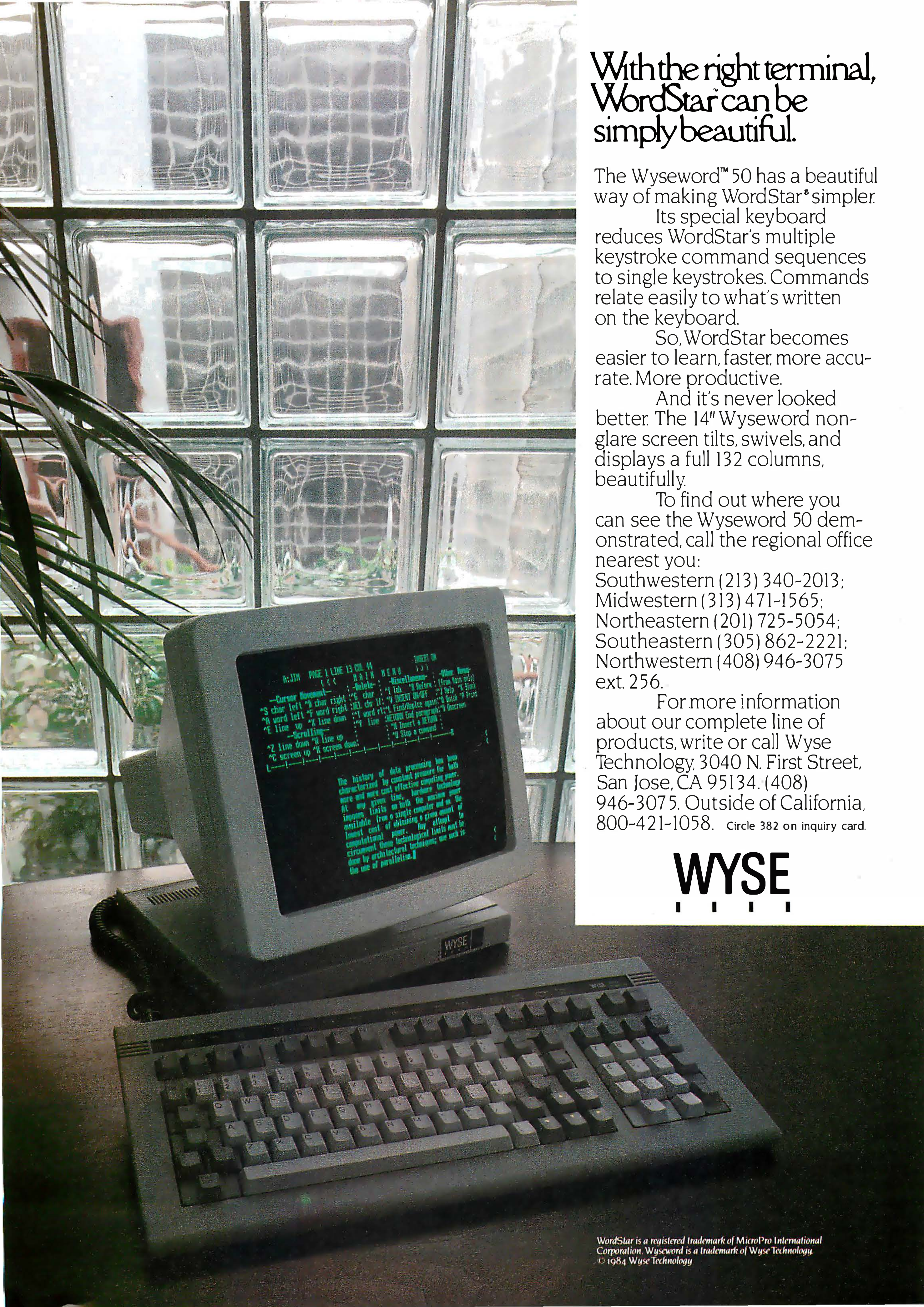
hampered by the constraints of a fixed record format with limited field lengths. Even on a stock template like an employee record, you can add as much (or as little) information as you like; because the whole document can be retrieved as a unit by assigning a title to it, length is not an issue.

By assigning keywords that link related data, it's possible to assemble into one report materials of many different types, including short text blocks, lengthy documents, memos, letters, and record forms. The database can grow to enormous size and, in fact, the program becomes more useful the more data you have; the more extensive the library of text, the more meaningful the topics on which you can prepare reports.

Using Text Databases

There is, of course, a price to pay for all this flexibility. Most of the programs currently in the categories I've described have made a few sacrifices to keep the command set, memory requirements, and processing time within reasonable boundaries. As a result, they're not all as easy to grasp as they might be.

But the beauty of text-database systems lies in the way they can free you from thinking of computers as merely a way to reproduce paper processes in an electronic medium. Filing and fetching are reduced to fast, complete routines; digging out resources becomes an easy, minor part of the creative process. More time can be spent creating rather than researching. ■



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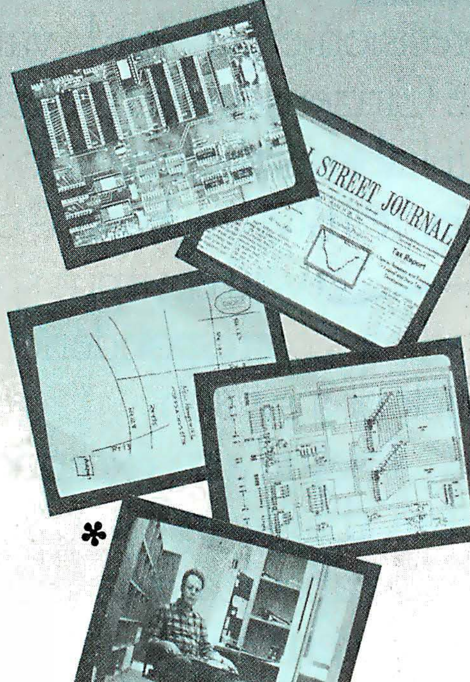
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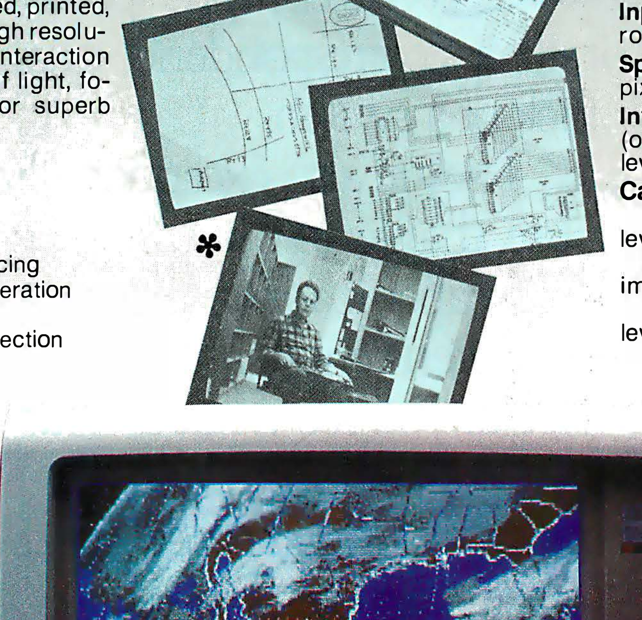


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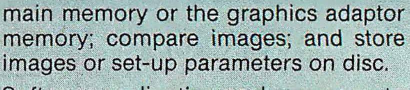
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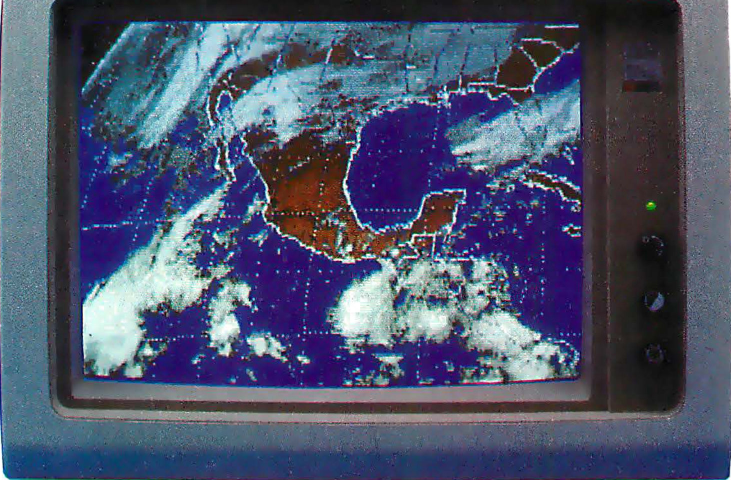
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THE DAYFLO ARCHITECTURE

BY ROBERT W. ATKINS AND WALTER L. MAZUR

A look at the internal workings of a free-form word-oriented database

THE TREMENDOUS GROWTH in personal computers over the last year or so has led to a great demand for simple yet powerful database-management systems for small computers. Unfortunately, just about all the systems available today use a traditional fixed-format type of database originally developed for mainframes and minicomputers. Such an approach, while perhaps acceptable for large corporate databases, is not quite as satisfactory as a personal-productivity tool.

There are two reasons for this. The first is that even when you're trying to keep track of a collection of items that have some common factors (a contact-management file, for example), in reality no two records are ever likely to be exactly the same. Someone is bound to have two phone numbers, or a foreign address, or an unexpectedly long title. Then you're faced with the almost impossible problem of squeezing all those odd bits of information into a format that doesn't allow for exceptions.

Secondly, and perhaps more significantly, it is not natural to expect that all the different types of information you'll want to record are going to fit nicely into predefined categories. For instance, do you file a note to be sent to a client in the contact file, the client file, the memo file, or some other file? Even if that decision can be made, will you ever be able to remember enough to retrieve it?

THE FREE-FORMAT APPROACH

Any real-world environment involving individuals requires much more flexibility than the fixed-format approach allows. One solution is to regard each record as unique but containing whatever common elements you choose. Furthermore, you should not have to know ahead of time how you're going to use the information you might want to enter impulsively. The concept of a schema or template for the database (which requires preplanning and locks you into a certain mode of operation) is unacceptable.

Since the majority of information processed by most individuals is textual in nature, fixed-length fields and fixed numbers of values per field are uncomfortably limiting. In addition, the data's textual nature suggests that the natural way to create and edit it would be with a text processor of some sort.

When we designed DayFlo, we integrated the database-management system with an appropriate text processor. We also developed an operational desktop metaphor—with stacks of records, a trash bin, a scratch pad, and a filing cabinet—that corresponds closely to the paper world with which most of us are familiar.

DATA RECORDS AS PAPER

In DayFlo, records are simply pieces of paper that can be scribbled on, edited, trashed, shuffled, moved around the desktop, or put back in the files. As you might expect, whichever record (possibly a blank one) is in front of you can be modified just by typing. In fact, in DayFlo you never leave the editor except momentarily to perform some utility functions. All

(continued)

Robert W. Atkins is senior systems architect at DayFlo Software and is the chief architect of the DayFlo system.

Walter L. Mazur is a senior member of the technical staff at DayFlo and was responsible for the design and implementation of the DayFlo database. They may be reached at DayFlo Software, 2500 Michelson Dr., Building 400, Irvine, CA 92715.

you do is pass different records through the editor. Thus, with a single keystroke you can move from record to record—editing or cutting and pasting, even creating new records—just by typing.

This paper model (as opposed to an exclusively forms-oriented one) requires a new method of database organization. Since a record can contain any sort of information and might not resemble any other in the database, the concept of different files within the database makes no sense. As such, the database cannot be described as either hierarchical or relational. Think of DayFlo's database as a single file rather like a shoe box into which you toss everything.

Retrieval of records from the database system is associative, based solely on the content of each record. For instance, you could say to the system, "Retrieve everything having to do with business plans or financing that concerns John Smith." The system would then locate a bunch of records, some of which could be memos, letters, reports, or just informal notes, and put them in front of you for your perusal. The top one is immediately available for viewing and/or editing and the others are easily accessible by either cycling or searching through the stack.

The Architecture of DayFlo

The architecture of DayFlo, as shown in figure 1, is both symmetric and open-ended. That is, any part of the system can call any other part of the system. Furthermore, all system functions return standardized function results, thus permitting DayFlo to keep track of the progress of all operations. The system is essentially a matrix of different types of operations that can be performed on different types of data and set up as a collection of relatively independent modules.

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SCREEN
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MOVE
RETRIEVE
DUPLICATE
RECORD
MANAGER
GET / PUT RECORD
GET ITEM / VALUE
VALIDATE VALUE
EXECUTIVE SERVICES
AND
OPERATING SYSTEM
DICTIONARY
MANAGER
DATABASE MANAGER
RECORDS AND INDEXES

Figure 1: *A simplified diagram of the DayFlo system architecture. The single lines represent top-level command flow between the components. The double lines represent internal command and data flow.*

Currently, the system includes a group of basic functions, such as the editor, a desktop organizer, a sorter, a find-and-retrieve processor, a screen-display manager, and so forth. It also supports standard data types, such as text, numbers, and dates, which are universally understood throughout the system. New functions and data types, however, can be added. This permits extended functionality relative not only to existing data types but also to new data types as they are added.

The underlying layer of DayFlo is host-independent, which makes it easy to port from one computer to another. This is the only part of the system in which assembly language is used (and then only in a few cases); the rest of the program is written in C, to further enhance portability. One of the key features of this bottom layer, called Executive Services, is a specially designed virtual memory and dynamic-linking facility. Executive Services permits DayFlo to make maximum use of all available memory by rolling out specific program modules when required. It also lets you call any function within the system (including those provided by add-on applications) without having to relink the system each time a new one is added.

The Command and Response processor handles all communication with the user and acts as a gigantic switch, capable of selecting the appropriate system module for each operation. It carries on simultaneous dialogues with both the user and the system to acquire and validate all the parameters necessary to perform each operation. Control is passed to the appropriate service routine only when validation is completed. Up to that point, a trace is kept of how the dialogue has progressed. This central control allows DayFlo to provide not only context-sensitive help but rapid error recovery. If you're on the wrong path, you can retrace your steps to the point where you went astray and head in the correct direction.

Because all dialogue is handled cen-

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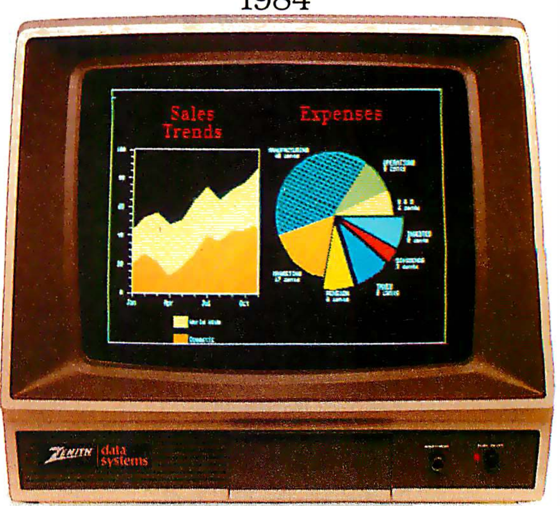
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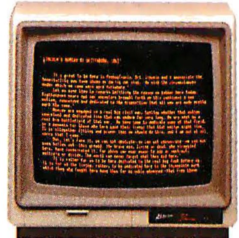




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trally, your perception of the system is one of a homogeneous whole, with very little implied structure. The isolation of all dialogue from the rest of the system also permits DayFlo to support different types of dialogue mechanisms without affecting the rest of the system. Thus, natural-language command implementations can be added, as well as user interfaces like mice, and speech recognition and generation.

INTERNAL MANAGERS

The part of the program that manages the database uses a simple, fast, multikeyed access method for the storage of all records in a single file—DayFlo's universe of data. This file is nonhierarchical, and its multiple keys permit data to be retrieved based solely on content. Optional indexing lets you flag those items that are of particular interest, thus optimizing their retrieval. Indexes are stored in the same place as the records themselves.

A dictionary is used to specify which items are to be treated globally throughout the system, their type definitions (used for data-entry checking, etc.), and whether they are indexed. The Dictionary Manager is responsible for providing information about a given item to the other parts of the system when needed. The dictionary is normally core-resident. At cleanup time it is archived in a fixed area at the start of the database file together with other dynamic tables (such as the configuration of the work area and the current editor settings) so that it's possible to resume working with DayFlo at the point where you left off.

The Work Area Manager is responsible for determining which records are currently in use. It also maintains a table showing the contents of all stacks and the trash. Additionally, it provides the necessary functions for moving records around the work area and for retrieving, sorting, and printing them.

DayFlo structures its database records in a manner unique among databases. While any record in DayFlo can be of any shape and size, internally they are stored as continuous byte streams of unique DayFlo characters. The DayFlo character set was specially designed to facilitate the types of operations performed in the DayFlo system. DayFlo records thus can be passed between the different components of the system, and the appropriate operation performed on them, without requiring transformations at each stage. Each DayFlo record contains not only the values of its items but also information about

(continued)



its structure and current state. The overall DayFlo record structure also provides a framework to which special representations of data can be attached, which can then be handled by add-on processors that understand this internal format.

From a database point of view, a DayFlo record is a series of items (or fields). Each item has a name and any number of values (see figure 2). The first item in any record is always "&UNNAMED ITEM" whose name is hidden from the user but that can be accessed for database retrieval. The special character STARTNAME (0F hexadecimal) marks the start of an item name. (Unless noted otherwise, the following values are hexadecimal.) STARTVALUE (0E) marks the end of the name and the start of the values. ENDVALUE (1D) separates one value from the next. Since all DayFlo records are variable length, there is no limit to the number of item names or values except the size of a record, 32K bytes.

The rest of the special characters used by DayFlo are ignored by the database but are used by DayFlo's word-processing functions. Lines are separated by NEWLINE (08), and extra spaces are inserted by the Editor for formatting by EDITBLANK (1C). Tabs are forbidden, as are any characters less than blank (20) or greater than DEL (7F). However, any character, x, from 00 to 1F can be represented by "1E 80+x", and any character from 80 to FF by "1F x". Thus, for example, on the IBM Personal Computer (PC), a "happy face" would be 1E 81, and a square root symbol 1F FB.

Changes in video-display attributes (underlining, etc.) are also represented by 2-byte codes. The first byte is always 05. The next byte is 80 with the desired video code added to it. The video code for reverse video is 1, underline 2, highlight 4, and blinking 8. Thus, code 05 8A makes subsequent characters underlined and blinking. The effect of a video code continues until the next video code, or the end of the value, or the start of the next item. The assumed video at the start of a value is normal (05 80).

DayFlo's ability to support free-format textual records is inherent in the relationship that exists between the Editor and the Record Manager. As you move around the work area, the Editor obtains from the Work Area Manager the designator of the current record. It then calls the Record Manager to get this record into memory for update. If the Record Manager doesn't find it already there, it makes a request to the Database Manager to read it into a specified location. The current values of any indexed items are then saved (so that the Database Manager can be told to adjust any indexes that may be changed when it comes time to write the record back into the database).

Name:	Pete James	Phone:	800-7DAYFLO▼(work)▼ 714-556-2312▼(home)
Company:	DayFlo Inc.		
Title:	Programmer	Type:	Friend (work)
Address:	2500 Michelson Drive; Building 400	▼	406 Nelson Ave.
City:	Irvine	▼	Costa Mesa
State:	CA	▼	CA
Zip:	92715	▼	92626
Notes:	Pete's main interests outside of work are outdoor activities. He likes to bike a lot and is an enthusiastic sailor. He is unmarried and has folks on the East Coast.		

Figure 2: *The above record is a contact-management record. Note both traditional forms-oriented fields like* Name: *and* Phone: *and also free-form textual items like* Notes:. *The presence of the* ▼ *symbol indicates that several items have multiple values.*

The Record Manager then informs the Editor of the location of the record and hands it over. Changes to the record are then made using DayFlo's standard word-processing commands. When editing is completed, the Editor returns the record to the Record Manager, which informs the Database Manager of any changes in indexes, and the record is rewritten.

Given the complexity of the DayFlo system and the relatively small amount of memory provided in modern microcomputers, a major performance factor is the fact that all the drivers understand the internal-record format. Thus, a record is displayed on the screen simply by having the Editor call the Display Manager and give it the location (both on the screen and in memory) of the first and last characters to be displayed. There is no requirement for additional buffers, and any needed translations are done as each DayFlo character is interpreted. Since all drivers are part of Executive Services, all machine/peripheral dependencies are localized in one component.

The Applications Manager provides general-purpose routines that allow new applications (like ReportFlo, DayFlo's document formatter and report generator) to be added to the system. It also lets the rest of the system get at special-purpose routines for such generic functions as Edit and Print.

The Utilities Manager provides a set of interactive routines that maintain the Dictionary and Database, including transferring information into and out of the system, and archiving and restoring it. When saving records, the Utility Manager uses a format (see figure 3) that is an extension of the DayFlo character set. This Save Record format also can be generated by programs other than DayFlo, which lets them transfer information into DayFlo with all the necessary item names, value separators, and video changes included.

Using DayFlo

The actions of the various managers are, of course, unseen by the user. DayFlo

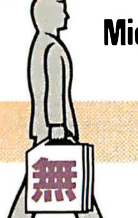
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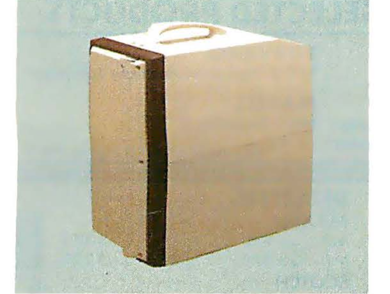




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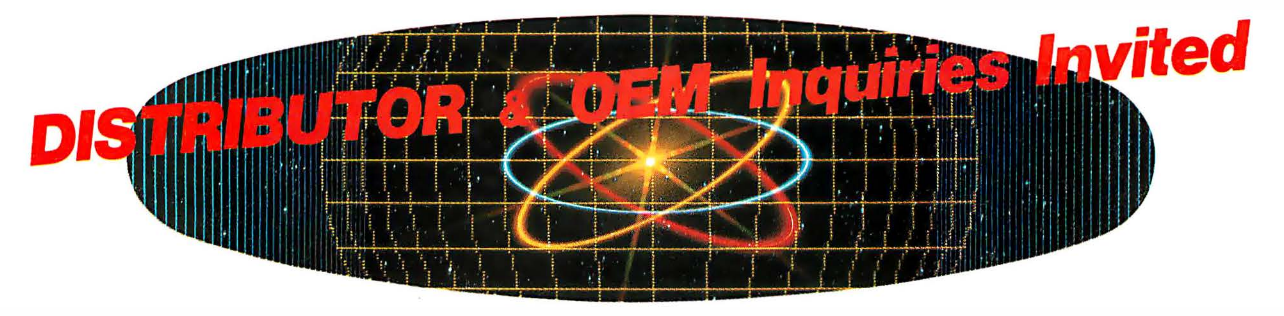




Hardware Specification

- **PROCESSOR**
  16 bit 8088
- **USER MEMORY (RAM)**
  256KB standard, expandable to 512KB on the system board(option). By optional 128KB expandable slot, total capacity is 640KB.
- **PERMANENT MEMORY (ROM)**
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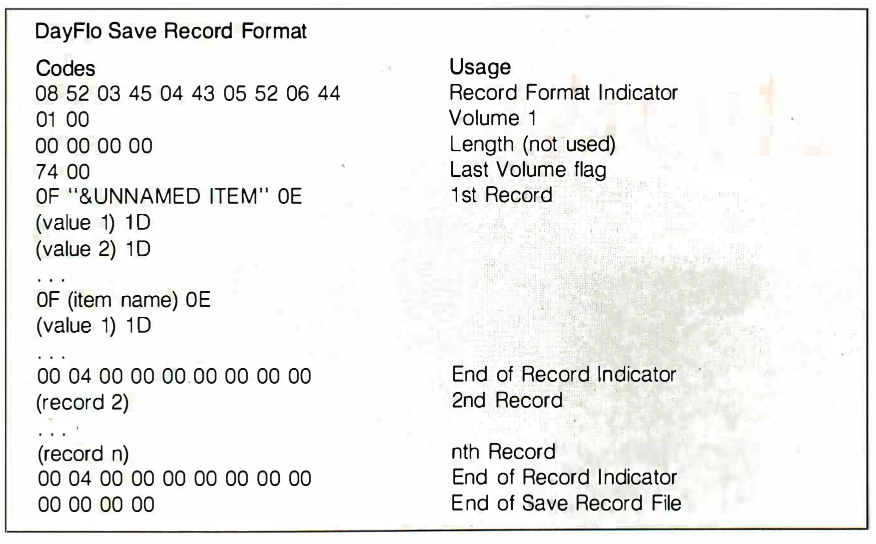




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presents a desktop view with 20 stacks (or folders) available for data extracted from the main database. You can move rapidly from one stack to another and thus shift from one project to another as your needs dictate. At any time you can either retrieve more material from the database or return items when you are finished with them.



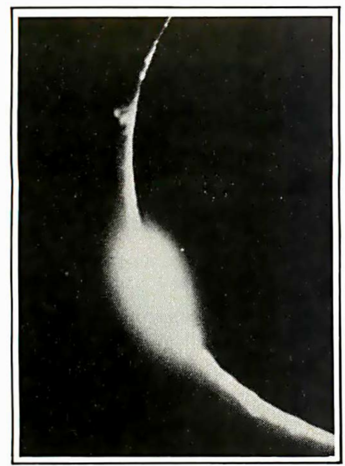
DayFlo Save Record Format

Codes	Usage
08 52 03 45 04 43 05 52 06 44	Record Format Indicator
01 00	Volume 1
00 00 00 00	Length (not used)
74 00	Last Volume flag
0F "&UNNAMED ITEM" 0E	1st Record
(value 1) 1D	
(value 2) 1D	
. . .	
0F (item name) 0E	
(value 1) 1D	
. . .	
00 04 00 00 00 00 00 00 00	End of Record Indicator
(record 2)	2nd Record
. . .	
(record n)	nth Record
00 04 00 00 00 00 00 00 00	End of Record Indicator
00 00 00 00	End of Save Record File

Figure 3: *The save-record format used by the Utility Manager to save DayFlo records. The actual format of each record uses the DayFlo character set.*

Because record formats are not fixed, it is simple to combine records into larger documents (without destroying the original source entries), which can then be stored as new elements. A larger item can be split into its component parts merely by reversing the process. Note taking is a relatively minor operation; you just move to a new line, name your new field, and begin typing. The note can be stored later as an independent record or left where it is.

DayFlo is designed for a full range of text-manipulation activities, from the generation of reports out of diverse source material to the maintenance of flexible-record files built on standard templates. Though free-form data operations are the basis of the DayFlo philosophy, you can easily develop record-keeping schemes that parallel those in fixed-format databases. ■



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Commodore 64 Benchmark (Sieve of Eratosthenes)	PROMAL	BASIC	COMAL	FORTH	PASCAL	
Execution Time (secs.)	30	630	490	51	55	
Object Code Size (bytes)	128	255	329	181	415	
Program Load Time (secs.)	3.2	3.8	6.3	11.2	23.5	
Compile Time (secs.)	8.5	—	—	3.9	108	

As the benchmark results in the table show, PROMAL is much faster than any language tested. From 70% to 2000% faster! And it generates the most compact object code. The PROMAL compiler is so fast that it can compile a 100-line source program in 10 seconds or less. And, not only is it fast in compile and run time, it also speeds programming development time.

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- Command oriented, w/line edit
- Memory resident
- Allows multiple user programs in memory at once
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- Program abort and pause
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- Line insert, delete, search
- String search and replace
- Block copy, move, delete & write to/read from file
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MODEMS

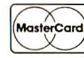
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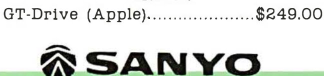
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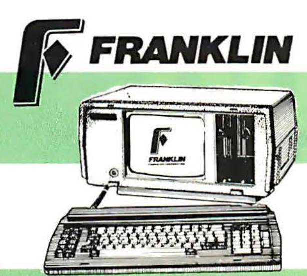
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LOW-COST ON-LINE DATABASES

BY MATTHEW LESKO

Cheaper ways to obtain information with your computer

WHY PAY DOW JONES & CO. a $75 initiation fee and up to a $72 per hour usage charge for stock quotations when you can get the same information for free? Why pay CompuServe up to an $89.95 initiation fee and a $12.50 per hour usage charge to find the latest weather trends when you can tap into the world's largest weather database for free?

The world of databases has entered the information age and, like all information products, it has quickly become a buyer-beware market. What someone sells on one side of the street for $100 to $200 per hour, someone on the other side of the street gives away or sells at a substantially lower cost. Unfortunately, most information and database buyers become aware of only those products that sell for high prices because they are most heavily advertised. Free or low-cost database suppliers are typically government or nonprofit organizations with no advertising budget or businesses that can keep their charges low because they have a small advertising budget.

Although many low-cost databases are available, don't think that database searching is an inexpensive way to obtain information. Recent studies show that major users of databases can spend an average of over $100 per hour searching for on-line information. Some databases charge more than $400 per hour, and if you are not familiar with the search procedure, you can ring up a substantial bill before you get any information.

Some of the major database vendors have such complex systems that, for a fee, they offer full-day training sessions to acquaint potential users with the system. I find it strange that vendors can charge for a course to tell you how to use their product in order to earn them more money. In the future this type of problem will decrease as more database vendors recognize the industry trends toward making systems user friendly and charging only for information units delivered in the form of abstracts, pages, print lines, etc.

Database users should be discriminating consumers. Don't take the first database that seems to fit your needs. Would you buy the first car you see? As databases proliferate (well over 3000 are now available), you will have to do a bit of shopping. You will find alternatives to most any database, but they might not be obvious. Doing some homework is worthwhile, since you might be able to cut 10, 50, or even 100 percent of your database bill. Here are some tips for reducing your on-line costs as well as a listing of some free databases and bulletin-board systems (BBSs), some of which you already support through your tax dollars.

Matthew Lesko is the author of six information and reference books, including Information USA *(Penguin Books) and* The Computer Data and Data Base Source Book *(Avon Books). He is also the publisher of* The Data Base Informer, *a monthly newsletter that identifies free and low-cost databases. For a free sample copy of the newsletter, contact Information* USA Inc., 12400 *Beall Mt. Rd., Potomac, MD 20854,* (301) 983-8220.

ON-LINE SAVING TIPS

You can start by saving money on nec-

(continued)

essary equipment. A modem can cost between $50 and $1000. The average price of a 300-bps modem is about $160; however, discounters are selling Anchor Automation's $80 Volksmodem for as little as $50. Telecommunications software can range from $50 to $200, but users clubs will offer you the basics for under $50.

If you are a beginner, be careful about buying a Cadillac when you need a Chevy. Your needs might change and prices will probably continue to drop during the next few years.

To save on connection expenses, use your subscription to MCI, Sprint, or other long-distance telephone discounters when tapping into databases. Although most major vendors offer local telephone numbers in major markets, many databases require a long-distance call, in which case a discounter can save you up to 35 percent of AT&T's rates.

A discount service can make your dialing procedure a bit more complicated. Some telecommunications software might require you to call the telephone discounter yourself, after which it uses the modem to dial into the database. Check with the telecommunications software manufacturer if you have problems.

You can also save up to 84 percent by using a database vendor's files at night rather than at prime time. But before you take advantage of night discounts, be sure you don't have a cheaper alternative. Pricing schedules can be complicated when you begin to figure in initiation fees, monthly minimums, and so on. Table 1 is a sampling of evening discounts from several major vendors (note that I.P. Sharp, SDC, and Vu/Text offer no night discounts).

Wholesalers can cut your costs by at least the amount you spend on initiation fees and monthly minimums. Business Computer Network offers subscribers access to BRS, CompuServe, NewsNet, and other services for a basic price of $50 per year or $5 per month. This saves you the $50 initial fee charged by BRS, the $15 monthly minimum from NewsNet, and the $39.95 to $89.95 initial fee charged by CompuServe. This appears to be a good idea, so you should watch for other wholesalers coming on line.

You can get a volume discount on management information. Executive Information Service by John Wiley & Sons offers unlimited use of four databases for a flat fee of $100 per month. The files are Harvard Business Review, Management Contents, Academic American Encyclopedia, and ABI/Inform. Using Management Contents and ABI/Inform (which cover most business-oriented literature) can be a bargain for big users because their costs range from $56 to $84 an hour on other systems.

Good Data Cheap

The Berkeley Solar Group, CompuServe, Dow Jones & Co., General Videotex, The Source, and WSI Corp. all offer the latest weather at prices ranging from $3 to $90 per hour. The cheapest appears to be the Berkeley Solar Group, which charges $3 to $12. Or if you want weather information free from Uncle Sam, see the free Climate Assessment Database later in this article.

Daily news junkies can find their cheapest hourly rate on CompuServe (Columbus, Ohio) at $12.50 per hour.

If you need more comprehensive information, you can pay $55 per hour to use Grolier's Academic American Encyclopedia on BRS, or $36 per hour to use it on Dow Jones. Or you can save yourself a bundle and use it on CompuServe for $12.50 per hour.

Other cheap sources of information are those files available on vendor systems that are also available from the producer at a cheaper rate. For example, the U.S. Federal Government has over 3000 files that vendors like Dialog sell to their clients at up to $100 per hour. If you have a big enough mainframe computer in your organization, you can purchase many of these files for under $200 and use them all you want. Other organizations, like the Bureau of the Census and the Department of Labor, are beginning to offer files in disk format. You can purchase them to cut down the cost of continually accessing a database for the information.

Of course, the best way to find out if something is of value is to try it for free. Dow Jones and Dialog offer free demonstrations and clinics. CompuServe offers a free trial with a special password. To find out more, contact the companies directly from the list in the text box titled "Directory of Database Vendors."

You can also find free listings of information and sources. GTE Telenet offers a 110-page directory that describes over 300 databases as well as 140 database vendors and computer services that use the Telenet system. I.P. Sharp offers two free monthly newsletters: one covers finance and the other energy. Contact the companies directly if you want further information.

Free Databases

The following is a descriptive listing of various free databases and bulletin boards that you can access. Where

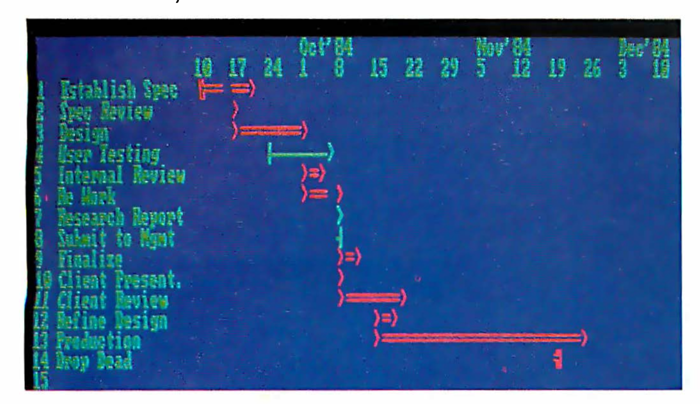
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Table 1: *Database night discounts.*

Database Vendor	Night Discount
Data-Net Inc.	84.4 percent
Dow Jones & Co.	22.2–78.3 percent
BRS	62.5–80.9 percent
The Source	62.7 percent
Dialog	53.3 percent average
CompuServe	52 percent
ADP (some services), Network	50 percent
Mead Data Central	50 percent on searching
General Videotex	45 percent
NewsNet	25 percent

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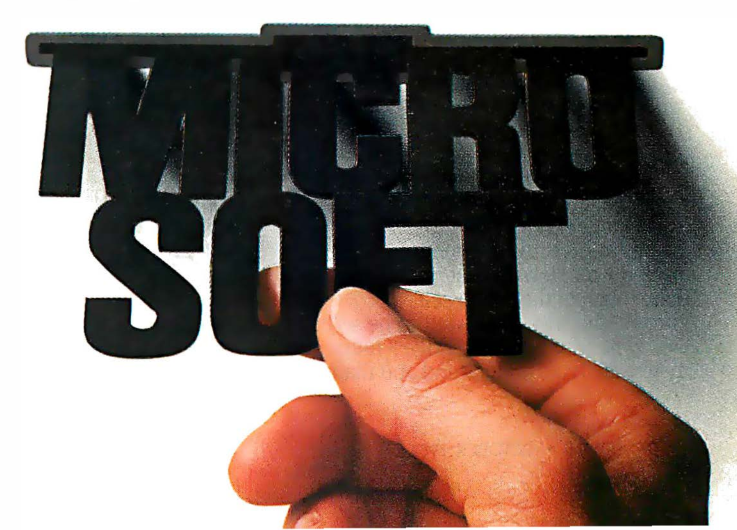
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I've given a name and address, you need to contact the database producer to receive the computer phone number and password. At times, access might be limited in order to deal with volume. I've provided direct computer telephone numbers in those instances where no password or authorization is required.

Foreign Affairs

Clearpoint International News offers daily transcriptions of news monitored from foreign dispatched national news agencies such as the BBC and Radio Moscow; this allows a comprehensive comparison of opposing perspectives on global events. On occasion, it also carries some regional news that cannot be obtained elsewhere. Contact Clearpoint, POB 31577, San Francisco, CA 94131.

The U.S. Naval Observatory has over 64 data files on time and travel covering such information as the time of sunrise, sunset, twilight, and moonrise on a given day anywhere in the world; the times transit satellites pass over a particular area during the upcoming 24 hours; and the direction and distance in nautical and statute miles between any two points on earth. Contact Mihram Miranian, U.S. Naval Observatory, Time Service Division, Washington, DC 20390, or call (202) 653-1079 with your modem at 300 bps. Make sure you use even parity.

The Climate Assessment Database provides information on short-term climate conditions throughout the world, including temperature, precipitation, weather indexes, heating and cooling days, energy conditions, and assessment of the climate's effect on crops. The information is updated continually from 8000 stations worldwide. For a password, contact Mr. Paterson, NOAA, National Meteorologic Center, W353, WBBB, Room 201, Washington, DC 20233, or call (301) 763-8071.

Another database contains plant-site-selection data and market demo-

(continued)

Directory of Database Vendors

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(313) 769-6800
(800) 521-3166

Berkeley Solar Group
3140 Grove St.
Berkeley, CA 94703
(415) 843-7600

Bibliographic Retrieval Services (BRS)
1200 Rt. 7
Latham, NY 12110
(800) 833-4707
in NY (800) 553-5566

Business Computer Network
POB 36
1000 College View Dr.
Riverton, WY 82501
(800) 446-6255
in WY (800) 442-0982

CompuServe Inc.
5000 Arlington Center Blvd.
Columbus, OH 43220
(800) 848-8199
(614) 457-0802

Data-Net Inc.
POB 652
Fairport, NY 14452
(716) 323-1141

Dialog Information Services Inc.
3460 Hillview Ave.
Palo Alto, CA 94304
(800) 227-1927
(415) 858-3785

Dow Jones & Co. Inc.
POB 300
Princeton, NJ 08540
(800) 257-5114
(609) 452-1511

Executive Information Service
POB 437
Somerset, NJ 08873
(212) 850-6360

General Videotex Corp.
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Cambridge, MA 02139
(800) 544-4005
(617) 491-3393

I.P. Sharp Associates
Box 418 Exchange Tower
2 First Canadian Place
Suite 1900
Toronto, Ontario
Canada M5X 1E3
(416) 364-5361

Mead Data Central
POB 933
Dayton, OH 45401
(800) 227-4908
(513) 227-4908

NewsNet Inc.
945 Haverford Rd.
Bryn Mawr, PA 19010
(800) 345-1301
(215) 527-8030

SDC Information Services (Orbit)
2500 Colorado Ave.
Santa Monica, CA 90406
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in CA (800) 352-6689

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McLean, VA 22102
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(703) 734-7500

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If you use your computer to analyze or make investments, one service provides the latest information on investment strategies, software and hardware performance evaluations, and computer-related investment techniques. It also provides a free software exchange program. Contact American Association of Individual Investors, 612 North Michigan Ave., Chicago, IL 60611, (312) 280-0170, or use your modem to call (312) 280-8764.

For those interested in the latest techniques and strategies for investing in the commodities market, another database has over 112 available files. These free files are provided by Club 3000 in Augusta, Michigan, and cover such topics as how to use the latest spreadsheets (such as SuperCalc) for analyzing trades, the best discount brokers, the latest software products available for commodity investing, and the good and bad effects of using the latest hot investment strategy. Use your modem to call (616) 731-5330.

If you need commodity news, from 4 p.m. to 7 a.m. you can get the latest on world commodities, the Minneapolis grain market, the Minneapolis wheat futures markets, and excerpts from commodity publications. Contact Nedbalek Enterprises Inc., 1154 Grain Exchange, Minneapolis, MN 55415, (612) 340-9030, or use your modem to call (612) 333-8970.

Micro Help

The National Bureau of Standards sponsors the Microcomputer Electronic Information Exchange BBS. Its number is (301) 948-5718. Contact Shirley Radack, Institute for Computer Sciences and Technology, A209 Administration Bldg., National Bureau of Standards, Washington, DC 20234.

If you have a technical question related to an Apple or IBM computer, place it on the Computerease Bulletin Board and the technical staff will try to help you. Contact Computerease, 2323 Boston Post Rd., Milford, CT 06460, (203) 877-7447, or use your modem to call (203) 878-6869.

Exec-PC is designed to help those who use an IBM PC or compatible for serious business pursuits. It offers the latest information on effective use of such programs as Lotus 1-2-3, dBASE II, and WordStar, as well as tutorials on databases, spreadsheets, and communication programs. Free software programs include PC-Write, PC-File, and PC-TalkIII. Use your modem to call (414) 964-5160.

Pacific Net-Works helps you locate any kind of PC software you might need and even lets you use an 800 number to call its free service if you are a regular user. Regular users are those residing in southern California who use the service at least three times a week and others who use it at least once a week. Use your modem to call (805) 985-2591 between 6 a.m. and 6 p.m. PST and 24 hours a day on weekends.

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Miscellanea

The Alternative Fuel Data Bank contains information about the use of alternative fuels in three data categories: bibliographies of publications, synopses of ongoing research activities, and discussions of topics of current interest. Contact Russell Simkis or Carol Morrison, Alternative Fuel Data Bank, Bartelsville Energy Technology Center, POB 1398, Bartelsville, OK 74005, (918) 336-2400.

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Microserve, located in Hawkins, Texas, offers you 20 minutes of free time on a variety of on-line databases and bulletin boards that include information such as the latest sports scores, weather, a listing of 800 numbers, horoscopes, and software and hardware products, as well as the national telephone listing of Source-net and Telenet. Use your modem to call (214) 769-3036.

The Handicapped Educational Exchange, located in Silver Spring, Maryland, provides information on how the latest technology can aid the disabled. Topics covered include computer use by the disabled, buying special equipment (such as braille printers) at the lowest possible prices, meeting notices, and listings of organizations for the disabled. Use your modem to call (301) 593-7033.

Information Intelligence provides current job openings throughout the United States and Canada in the field of library automation. Also on file is a directory of on-line employment sources, as well as job lines and hot-lines. Job openings remain on line for 30 days.. Contact Information Intelligence Inc., POB 31098, Phoenix, AZ 85046, (602) 996-2283.

If you are still looking for the ideal BBS, keep up on the latest in bulletin boards by using your modem to call any of the following directory numbers: (213) 653-6398, (619) 561-7277, (818) 881-6880, or (913) 649-1207. ■

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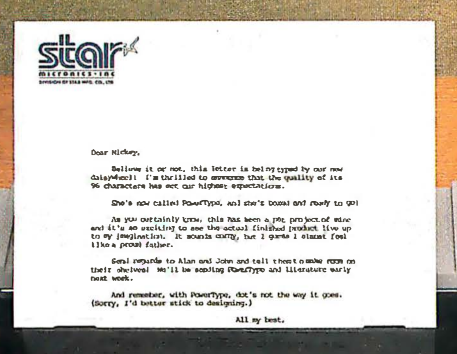
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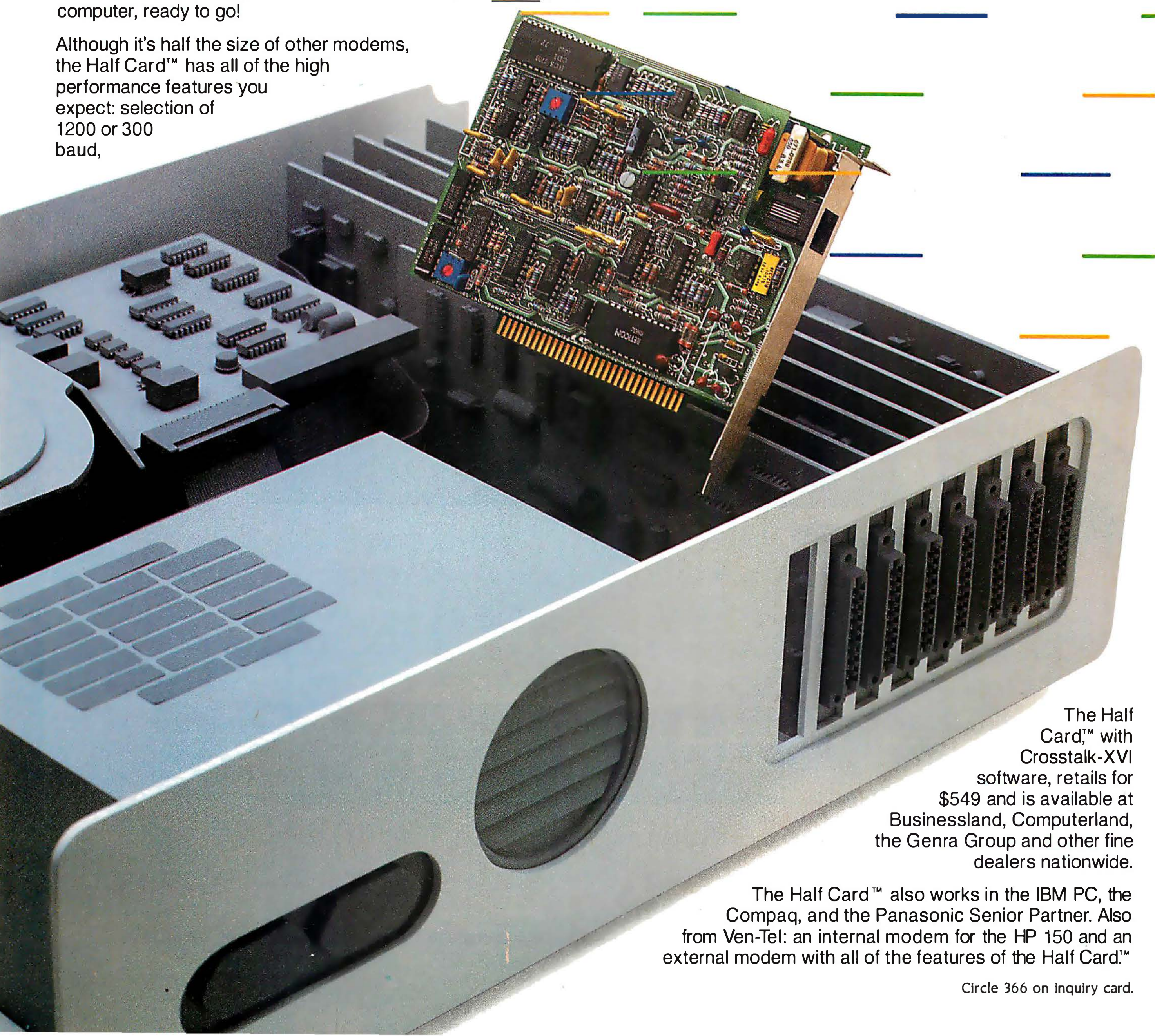
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THE PICK OPERATING SYSTEM

PART 1: INFORMATION MANAGEMENT

BY RICK COOK AND JOHN BRANDON

This information-oriented operating system has a built-in relational database and multiuser capabilities

[Editor's Note: You might ask why BYTE *has included an operating system article in this month's database theme. We had two reasons. First, the Pick operating system includes a built-in relational database and an easy-to-use English-like query language. Second, Pick, like* UNIX, *is a large, complex operating system that is migrating from minicomputers to microcomputers and is well suited for managerial and business applications.*

This month, in part 1, Rick Cook and John Brandon introduce the Pick operating system and discuss its structures, query language, and dictionaries.]

THE REAL JOB of a computer in a management context is reducing data to information and helping people manage the information. One way to measure how difficult that can be is to consider all the times you confuse data with information and end up processing data instead of managing information.

Data includes such things as invoice numbers and customer addresses, price lists, and style codes. Information answers questions: Am I making or losing money? Have I got enough material on hand to produce what I need for next month? Where did I put that magazine article? How well is George doing in sales? Why does it cost so much to answer a customer letter? And how much does it cost, anyway?

By using computers you can sort out relevant data, better discern important relationships, and apply both to the questions at hand. But on most computer systems, machine needs (and not user needs) predominate. Instead of helping you squeeze information out of the real world, the computer traps you in an unreal world conditioned on its own structure.

Ideally, the structure of the query put to the computer should match the structure of the problem. You should be able to think in terms of questions and answers and convey them to the computer without having to translate them into a language of files and fields, record lengths, and search keys.

Unfortunately, reality is not static. Not only does the data change, but relationships change, too. You try new ways of doing things, new people join the business, responsibilities shift, even the rules and laws you follow change. The computer's metastructure should adapt to these changes as they occur.

The Pick operating system represents one attempt to meet this challenge. Pick is a virtual-memory multiuser operating system specifically designed to help you get the information you need. The structure of Pick focuses your attention on information rather than on the workings of the computer.

Although it is an extremely sophisticated system, Pick is easy for nonprogrammers to use. In a few minutes, you can learn Pick's English-like query language well enough to begin

(continued)

Rick Cook (2318 West Hayward, Phoenix, AZ 85021) is a freelance writer specializing in computers and high technology. He has written for Popular Computing *and many other computer magazines. John Brandon (2432 West Peoria Ave., Suite 1303, Phoenix, AZ 85029) has worked with the Pick operating system for eight years and is president of Interactive Systems, a Phoenix corporation that supplies software, education, and consulting for the Pick operating system.*

answering complex questions about data stored in the built-in relational database. With a little more work, you can learn to modify the commands, write elaborate instruction sequences that can be stored and used as needed, and work in the high-level programming language that is part of the system.

The closest thing to Pick in size and feel is probably UNIX. Both are big, complex operating systems that are migrating down to the microcomputer world after having been developed and refined on minicomputers. Both systems are sophisticated and very powerful, and both tend to produce vehement partisans. One of the big differences, though, is that UNIX partisans tend to be programmers, especially systems programmers. Pick's partisans tend to be users and applications programmers. Of the two systems, UNIX is the more powerful for scientific and engineering applications. Pick, by its structure, is better adapted for business and managerial applications.

But Pick is hardly perfect. Structured programming purists shudder over the fact that Pick's only high-level language is an extensively reworked version of BASIC. The present release is multiuser, but not multitasking, and rather lacking in communications capability. Some of the UNIX-type concepts, such as pipes and filters, which are becoming widely available on other operating systems, are not fully developed in Pick. Software hackers generally dislike Pick because it is difficult to get inside the system and play with it.

On the other hand, for the manager who needs to find out what's going on, the applications programmer who has to get a piece of software up and running, or anyone with a lot of information to organize, Pick's design and structure make it hard to beat.

If Pick is so good, you might well ask, why isn't it better known? That's a question Pick enthusiasts frequently ask themselves. Part of the answer is that, until recently, Pick was confined to the minicomputer world, where it was generally sold under a house name. Microdata, for instance, calls its version of Pick "Reality." Another reason is that, unlike some operating systems, Pick has been carefully controlled. It is not available on all machines, and Pick Systems Inc. has no intention of making it available for all of them. Pick software is highly portable, but the operating system itself is not. Getting Pick running on a new machine takes a lot of work.

Although most of the microcomputers running Pick are high-end multiuser systems costing $10,000

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and more, Pick Systems Inc. has recently transported Pick to the IBM PC XT. The PC version of Pick is a full implementation that supports up to three users and sells for $495.

An Overview of Pick's Structure

Although Pick is technically an operating system, it contains much more than the regular operating-system functions. As part of the operating system, Pick has a wealth of features that are applications programs or add-ons in other systems.

The heart of the Pick operating system is its relational database. In Pick, the database-management system is an inherent part of the operating system and not a utility or an add-on.

Other parts of the operating system include an English-like nonprocedural query language called Access; a compiled version of BASIC with major enhancements for business and data management; Proc, a stored-procedure processor that lets you write and store elaborate command sequences, much like scripts in UNIX; a command processor called Terminal Control Language (TCL, pronounced "tickle"); a print spooler; and a number of other utilities. You will spend most of your time with Access, TCL, Proc, and BASIC.

Most of the utilities associated with microcomputer operating systems are either invisible or nonexistent in Pick; as much as possible, chores like file handling and memory allocation are done by the operating system. You are free to concentrate on the information. However, Pick is rich in utilities related to information handling.

Underpinning all of this is an elaborate and complex software structure. Pick is implemented as a virtual machine with limited, carefully optimized connections to the underlying hardware through a section of code called the monitor. Pick's designers started out by coming up with the best possible paper computer they could imagine for managing information. Then they wrote an operating system to emulate their design on real computers.

The Pick virtual machine has its own internal structure and even its own pseudo-assembly language, all designed for data-management tasks.

On a microcomputer, these features are implemented in software, right down to the virtual-memory management system. One result of having a virtual machine implemented in software is a high degree of applications portability. Any Pick machine will run almost any piece of Pick software. The only difference between running an application on an IBM PC XT and an IBM 4300 mainframe is that the application will probably run slower on the PC XT.

The usual penalty for having such an elaborate software superstructure is a loss of speed. You would expect that Pick would be slow, especially on something like the 8088 microprocessor in an IBM PC XT. That's not the case.

While the PC XT implementation is noticeably slower than Pick on 68000-based microcomputers, it doesn't drag. To someone used to microcomputers, Pick appears somewhat slow because most Pick implementations are designed to work with terminals via serial I/O (input/output) ports rather than the kind of memory-mapped video used on most microcomputers.

Processing speed, however, is good, especially on things like searches and sorts. The Pick operating system contains many commonly used functions, such as database management and the high-level BASIC language. Because these functions are so tightly integrated with the overall operating system, they tend to run fast.

There are a couple of other reasons why processing speeds stay reasonable. For one thing, Pick executes as machine-language code on whatever machine it is running on. Other operating systems that use the virtual-machine concept are usually interpreted or compiled/interpreted. Another reason is that Pick is carefully optimized for each implementation to be as fast as possible. That is one of the reasons Pick isn't as portable as

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an operating system written in a high-level language. That said, it's important to note that Pick is not a number-crunching system. There are better operating systems for scientific and engineering work or for anything else that requires a lot of calculation. Pick will score poorly on a computational benchmark such as the Sieve of Eratosthenes.

On the other hand, Pick will shine in an information-management test, particularly one with a lot of complex data manipulation. Because the database is relational and because of the way the system stores information, it can usually retrieve any piece of data with one or two disk accesses.

The Pick File Structure

Part of Pick's strength comes from its file structure. Everything is contained in a file and the files are organized hierarchically.

There are three kinds of files in Pick, but you only have to deal with two of them—data files and dictionary files. (The third kind, binary files, hold compiled code and stored lists.) Both kinds of files are structured in the same manner. Broadly, the distinction between data and dictionary files is that data files hold the data and dictionary files establish and maintain relationships between the data.

In Pick, there is ony one type of data file, but there are three types of dictionary files. The system dictionary defines the users (accounts) on the system. The master dictionary for each user defines the user's vocabulary, while data dictionaries describe the data and define the relationships (see figure 1).

One of the beauties of this separation of data and dictionary files is that it makes it easy to change relationships without affecting the data, and vice versa. Dictionary files can be edited, updated, or changed completely without disturbing the data entries to which they refer. In the same fashion, you can edit and update data without making any modifications to the dictionaries or disturbing the relationships already created. This gives you the flexibility to change the system as the real world changes.

If, for example, you need to go from five-digit to nine-digit ZIP codes, you can call up the ZIP-code item in the appropriate dictionary and change the length from five to nine digits. That takes about 30 seconds. Since data is stored only once in a well-designed Pick data structure, that change ripples through to every use in the system. (You still have the problem of updating the existing ZIP codes. Pick is neat, but it isn't magic.)

If you need five-digit ZIP codes for some uses and nine-digit codes for others, you can easily specify that, too. The system will present only the relevant five digits to the users that need it that way. If you only have five digits, there is no need to enter nulls or asterisks to take up the additional

(continued)

Figure 1: *The Pick file hierarchy. There is only one system dictionary on the Pick operating system. Beneath it are any number of master dictionaries, one for each account on the system. Each master dictionary can have any number of data dictionaries beneath it, and each data dictionary points to one or more data files. A master dictionary and the subsidiary dictionaries and data files make up a user account on Pick.*

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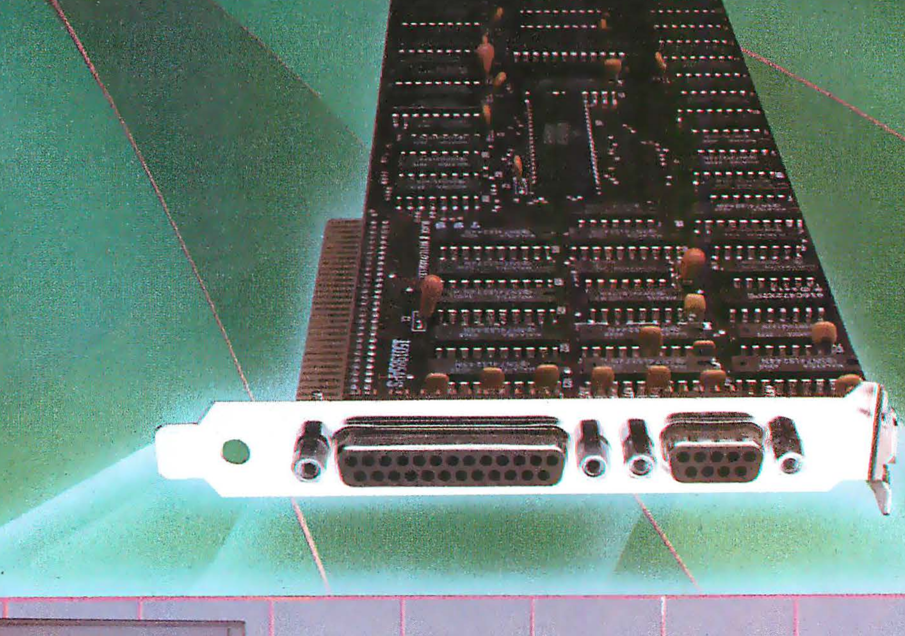
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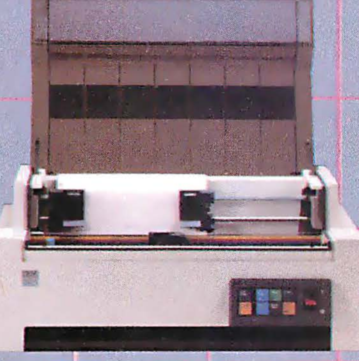


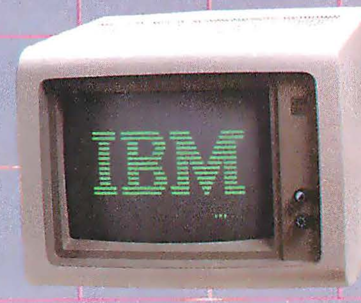
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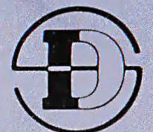








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space. In fact, the system doesn't care how many characters are entered as the ZIP code; 5, 9, 20, 200, or none are all acceptable to the system. Of course, the applications programs would normally include checking routines to make sure only acceptable values were used. But that is your choice, not something forced on you by the database-management program.

Because of the data file and dictionary *structure*, data can be stored in any convenient form or length in the data file. Pick includes a large number of conversions and maskings that can be applied from the dictionary to produce output in the desired form.

The basic subdivisions of a Pick file are:

- file
  - item
    - attribute
      - value
        - subvalue

A file is just what it is in any system: a collection of information that is (at least theoretically) related. In Pick, files can be any length and space is dynamically assigned for them. A single file can grow to fill an entire disk or shrink to almost nothing without intervention by the user or programmer.

An item in Pick is roughly equivalent to a record in a conventional database system (see table 1). In the present implementation of Pick, items in a file cannot be longer than 32K bytes. If that's not long enough for your purposes, you can link several items. However, in Pick, it is considered better design to use a number of small items rather than one large one. It is uncommon for items to seriously press the 32K-byte limit.

An item is normally subdivided into attributes in the same way a record in a conventional database is subdivided into fields. Here, however, the parallels are less distinct. For one thing, within an item, the attributes, values, and subvalues that can make up items are not positionally oriented. Attributes, values, and subvalues are free to grow and shrink as needed. Like an item, the size of an attribute is variable up to 32K bytes, although the total length of the item containing the attribute must also stay under 32K bytes.

What's more, attributes can be added to an item at any time without disturbing the other attributes, relationships, or programs that use the item. The added attributes become a part of the item and they can be operated on in the same way. They are just ignored by the programs that don't need them.

To separate things inside an item, Pick uses delimiting characters rather than predefined field and record lengths. Attributes are delimited by hexadecimal FE (decimal 254), values are delimited by hexadecimal FD (253), and subvalues by hexadecimal FC (252). The user doesn't have to worry about inserting these marks; it's done automatically. Attributes within an item are referenced by their attribute number.

Figure 2 shows three typical items (or records) in a data file, in this case an inventory file. The attributes in each file are separated by a caret, which is the way Pick documentation represents the attribute delimiter. Notice that the attributes vary in length from item to item, and each

(continued)

Table 1: *The file structure of the Pick operating system compared to a conventional database.*

Pick	Conventional Database
File	File
Item	Record
Attribute	Field
Value	—
Subvalue	—

takes up only the amount of space it needs. Note, too, that the file consists entirely of data. Information on what that data means is kept in the corresponding dictionary file.

The exception to this kind of free-style format is the first attribute in an item. This is attribute 0, or the ITEM-ID, which is the key for retrieving an item from a file. (See the text box, "Attribute 0, Modulo, and Separation" on page 190.) It is limited to 50 characters and it must be unique within the file. In other words, there can't be two items with the same attribute 0 in the same file, although there can be in different files.

An attribute other than attribute 0 can have multiple values, and each value can have multiple subvalues. By using attributes, values, and subvalues, a programmer can construct elaborate three-dimensional data matrices within a Pick item. This structure is called a dynamic array, and once you get used to it, it is a powerful tool for creating data structures that closely model the real world.

The Pick file structure explains a great deal about the power Pick offers. To really understand the way in which Pick handles data, you have to look at two closely related subjects—the Access query language and the way a data dictionary works. The best place to start is with Access and what it does. In a very real sense, data dictionaries exist to support Access.

THE ACCESS QUERY LANGUAGE

Access is designed to make it simple to turn data into information. It is easy to use and lets you get fast answers to even very complex questions.

The simplicity of Access stems primarily from three things: it uses words or universally recognized symbols (such as +, >, =) to express concepts, it requires a minimum of extraneous information from the user, and it works the way a user thinks. One result is that novices who are taught Access quickly feel at home with it. They can formulate questions in a perfectly natural way and then ask those questions in almost the same format.

Commands in Access are called verbs. They are action words like LIST or SORT. The usual sequence of an Access command is verb, filename (selection criteria, sequence criteria, report output attributes, and modifiers). However, you can use any sequence that seems comfortable as long as it starts with a verb. The elements in parentheses are optional. This follows the sequence you would use in asking a question of another person. "How many of the new PC boards for the RS-232C interface have we got on hand and what departments have them?" becomes:

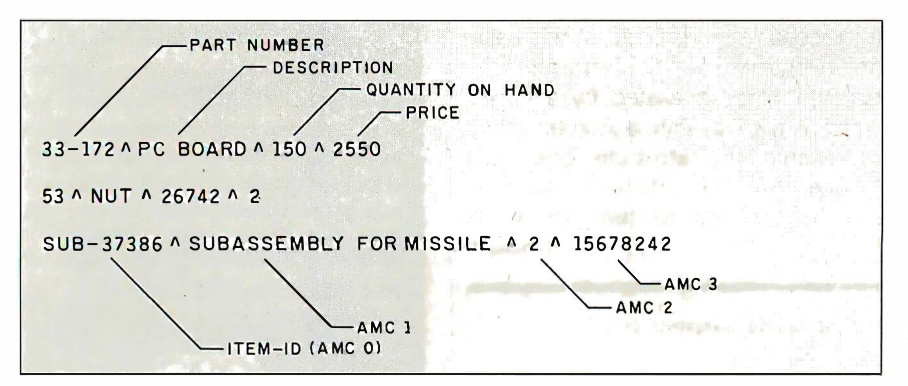


Figure 2: *Data in a Pick file. This illustration shows three data items (records) from a Pick data file. In Pick, data is stored as unformatted strings of ASCII characters. The caret is the Pick convention for representing the separation of attributes (fields). Attributes are numbered by an attribute mark count (AMC) indicating their position in the item. A file may contain an unlimited number of items and within items attributes are totally variable in length.*

LIST THE INVENTORY FILE WITH PART-NUMBER "RS-232C-BOARD" DEPARTMENT TOTAL QUANTITY-ON-HAND.

This example assumes you have an Inventory file and attributes identified as PART-NUMBER, DEPARTMENT, and QUANTITY-ON-HAND.

In addition to verbs such as LIST and SORT, Access includes *relational* operators such as > and = and Boolean operators such as AND, OR, and NOT, which can modify them. You can stack up to nine separate selection criteria separated by AND operators into a single Access sentence. If you don't get the information you need with the first sentence, you can reformulate the query and t y again or follow where the answer leads you. In use, Access is highly interactive. One question tends to lead to another as you zero in on the information you want or pursue the questions raised by the answer to the first question.

One way a system turns information back into data is to tell you more than you want to know. Computers are experts at this. In our example, all the questioner wants to know is how many parts are on hand and who has them. Other people in the company might need to know the part's price, vendor, quantity on order, quantity on back order, the amount owed the vendor, the shipping weight, when the next shipment is due to arrive, and perhaps 50 other things. All this information might be in the database, but giving any of it to the questioner would be unnecessary.

To prevent this, Access lets you specify selection and output criteria. This system shows you only what you are interested in. The rest of the information remains invisible and, in fact, may not be accessible to you as a security measure.

Here's a more complex Access sentence:

SORT INVENTORY WITH QUANTITY-ON-HAND < "50" AND WITH LEAD-TIME > "30" OR WITH

(continued)

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This sentence produces a printed report (LPTR stands for line printer) consisting of part numbers, descriptions, lead times, and quantities on hand for parts with lead times of more than 30 days with less than 50 in stock and lead times of less than 30 days if there are less than 10 in stock. The report will be printed out with each vendor starting on a new page (break-on) and with the headings "Part Number," "Description," "Lead Time," and "Quantity on Hand."

These are simple examples of Access sentences, the sort of thing you might be doing the first day or two you use Pick. Access contains a rich variety of commands and options that give it great flexibility in managing information.

Generally, an Access sentence has three parts: the commands to select and operate on the data, the output field information telling the system what the user wants to see, and modifiers and options that let the user specify the output format, print headers, and so forth.

(continued)

ATTRIBUTE 0, MODULO, AND SEPARATION

The reason for the attribute 0 size limit and the requirement that attribute 0 be unique has to do with its function. Attribute 0 is a keyword that identifies the item, so it must have a unique identifier. In addition, the system uses it to determine where to store the item on the disk.

The data and program storage space in Pick, both RAM (random-access read/write memory) and disk, is divided into "frames"—pages of 512 bytes each. For programming purposes, the frames on disk are organized into "groups" of frames, and a file is usually divided among several groups. When an item is added to a file, the system puts the keyword (in attribute 0) through a hashing algorithm and the result determines the group in which the item will be stored. Since it is possible for several ITEM-IDs to hash to the same group, the hashing algorithm doesn't give a unique location for the item. What the algorithm does do, however, is quickly determine which group of frames the item will be stored in—and which group to search to retrieve it.

If the space allocated for that group is full or if the item overflows (grows beyond the space available in that group), additional frames will be drawn from the pool of unallocated storage, linked to the group, and the data will be stored in them. If the item shrinks, the frames will be unlinked and returned to the pool of available storage space.

The advantage of this system is that no matter how big a file gets, the search for any item or part of an item will be limited to one group of frames and it takes relatively few motions of the disk head to find an item. In other words, group size rather than file size determines search time.

The matter of group size is particularly important because of the way Pick divides resources among users. Each user on the Pick system gets a share of the system's time, called a time slice. The user's time slice ends either after a certain interval or before that if the user's application needs a page that's not in RAM. In the latter case, the operating system makes note of the user's need for a fresh page and goes on to the next user. When the first user's turn comes around again, the operating system has obtained the needed page and processing continues. Naturally, this is all invisible to the user. The only thing that isn't invisible is the time that it takes.

Suppose a file occupies five pages of memory and is organized into a single group, and suppose that the data sought is at the very end of the group. The operating system finds the group immediately by applying the hashing algorithm to the ITEM-ID, but then the system has to search sequentially through the group for the data. It starts searching at frame 1, doesn't find the data, needs to go to the next frame, and loses the time slice. The same thing happens at every frame boundary and it takes four time slices to find the data.

Now suppose the same file is organized as five groups of one frame each. This time the operating system goes to frame 5 and finds the data on the first search. The system seems much faster to the user and it is certainly more efficient.

On the other hand, making the number of groups too large is also inefficient. Each group occupies at least one frame in memory. If the programmer sets the number of groups (modulo) at 10 for a file that holds only one item, the other nine frames are wasted.

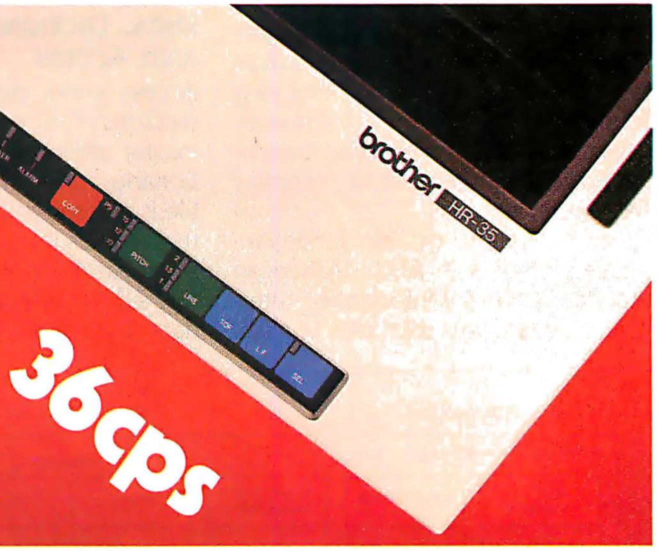
Pick allows the programmer to change an item's modulo at any time. The system generates a report called "filestat" (for file statistics) that indicates how much overflow there is in each file. When the overflow becomes excessive, the programmer can change the modulo of the overflowing files, thus reducing the overflow.

Reducing overflow is one of the fastest ways to speed up a poorly performing Pick system. The other one is to add RAM. Due to the design of the system, adding hard-disk storage makes no difference in operating speed.

It is also possible to set the initial number of frames in each group, or "separation." When the separation is more than one, the frames allocated will be contiguous on the disk. In theory, choosing the proper separation should have a major impact on system performance, since the frames in a group could be accessed with minimum disk-head movement. In practice, it usually doesn't matter. Most of the time, another user will require disk access between your disk accesses, which effectively randomizes the head position. Most Pick programmers leave the separation at one.

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In Access, the same piece of information can be called by different names and it is easy to define synonyms.

Synonyms can be defined for the commands in Access, too. If you prefer DISPLAY to the Access verb LIST, it is simple to define DISPLAY as a synonym for LIST. If you want to use words like "please" in Access but have the computer ignore them, that's easy to do, too. In short order the results begin to look like natural-language programming. It also makes foreign-language versions of Pick easy to implement. All the commands, verbs, etc., can be given their foreign-language equivalents. If a company has users who are more fluent in Spanish, French, or any other language written with ASCII (American Standard Code for Information Interchange) characters than with English, there is no problem accommodating them. Meanwhile, no one else on the system is affected, no matter how much a user plays with the entries in his or her account. In the same way, a programmer can define a complex series of commands as a procedure, or "proc," to be called by a single word. In this way an inexperienced user can perform complicated jobs in a simple, natural fashion.

Data, Dictionaries, and Access

Access works closely with the Pick dictionary files, especially each user's master dictionary and the data dictionaries to which it points. Each data file is pointed to by a data dictionary that defines the data and its relationships. Attributes in a data-file item are defined by corresponding items in the data dictionary. The data dictionary can also define information that isn't in the file, such as quantities that are computed rather than stored directly or data that is elsewhere in the database.

This can get confusing. Because Pick's file structure is so regular, there are items and attributes in both dictionary and data files. To keep things straight, we will call the item in the dictionary the DICT-ITEM and the attributes in the dictionary item the DICT-ATTs. The data item will be DATA-ITEM and its attributes will be DATA-ATTs.

Figure 3 shows how the DICT-ITEM and the DATA-ATT relate. The DICT-ITEM PRICE defines and specifies the fourth DATA-ATT for each DATA-ITEM in the data file. To the system, the fourth DATA-ATT in this particular data file is known by the name PRICE.

(continued)

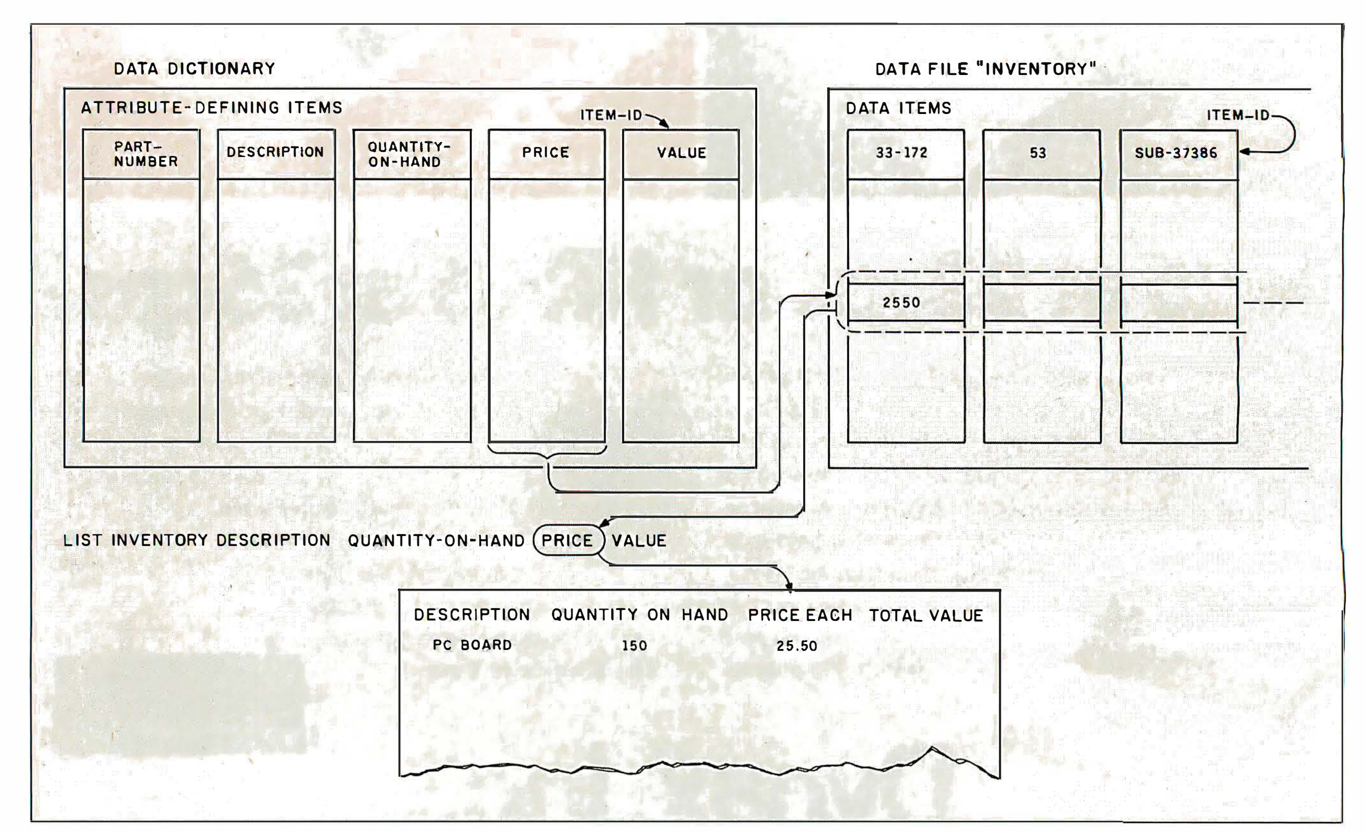


Figure 3: *The relationship of data dictionaries and data files. The data dictionary on the left contains data dictionary items with the* ITEM-IDs PART-NUMBER, DESCRIPTION, QUANTITY-ON-HAND, PRICE, *and* VALUE. *Each of these dictionary items defines a data attribute in the associated inventory data file. The dictionary item* PRICE *defines the fourth data attribute of every data item in the inventory file. The Access sentence asks for a list of data items in* INVENTORY *and instructs the system to display only the description, quantity on hand, price, and value.*



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That data can be called and operated on by name or a name defined as a synonym. For the user, the main significance of attribute 0, the ITEM-ID, is that it serves to name the item.

Notice that both the DICT-ITEM and the DATA-ITEM have an attribute 0. In this example, the DICT-ITEM's attribute 0 is PRICE, while the first DATA-ITEM's attribute 0 is 33-172, which happens to be the part number. In a DICT-ITEM, the ITEM-ID names the elements, which in turn define a DATA-ATT. In turn, the ITEM-ID of a DATA-ITEM is the key for retrieval and names all of the elements in the associated DATA-ITEM.

As you can see in figure 4, there is more to a defining item in a data dictionary than a name. Eight of the other 10 dictionary attributes can specify important parameters about this data attribute.

In our sample, the data-dictionary file contains DICT-ITEMs PART-NUMBER, DESCRIPTION, QUANTITY-ON-HAND, PRICE, and VALUE. To see what defining a DATA-ATT involves, let's look at the DICT-ITEM PRICE (see figure 4).

The first DICT-ATT in the DICT-ITEM is the ITEM-ID, in this case PRICE. It is the name for the data stored in its associated DATA-ATT. The second DICT-ATT is an A, for attribute. This tells the system that this DICT-ITEM defines a DATA-ATT. (This is one of about a half-dozen possibilities for DICT-ATT 1.)

The next DICT-ATT is the AMC, or attribute mark count. It tells the system which DATA-ATT this DICT-ITEM defines. Counting the ITEM-ID as AMC 0, the DATA-ATT is the fourth DATA-ATT from the beginning of the item, so the AMC is 3.

The next DICT-ATT is the column heading to be used when the DATA-ATTs are displayed or printed out. The heading can be anything and can occupy more than one line on the display if needed.

DICT-ATT 4 (which is not used in this example) is used when a DATA-ATT contains multiple values or subvalues that are directly related to values or subvalues in another DATA-ATT. For instance, a jeweler's inventory might have a particular kind of watch with multiple values in the DATA-ATT for style and multiple values in the DATA-ATT for price. DICT-ATT 4 provides a way to match those sets of values and make sure the proper pairs appear together on displays or printouts.

DICT-ATTs 5 and 6 aren't used in a DICT-ITEM defining a DATA-ATT.

DICT-ATT 7 specifies any needed conversions. An entry here tells the system to apply some sort of formatting, masking, or other conversion process to the DATA-ATT before printing or displaying it.

Remember, in Pick the output specifications and the internal representation of data are only loosely coupled. This is one of the secrets of the system's flexibility. To take a simple example, Pick offers several options for displaying the date. Actually, Pick stores dates internally as the number of days after December 31, 1967 (a date, by the way, of no apparent significance to anyone except Pick's developer, Richard Pick). Similarly, time is figured internally as seconds after midnight, but it can be displayed as military time, regular 12-hour time, hours-minutes-seconds, or whatever.

Although the starting date for the system's internal representation of the date may be arbitrary, the method used to store the date is well thought out. Most systems and applications

(continued)

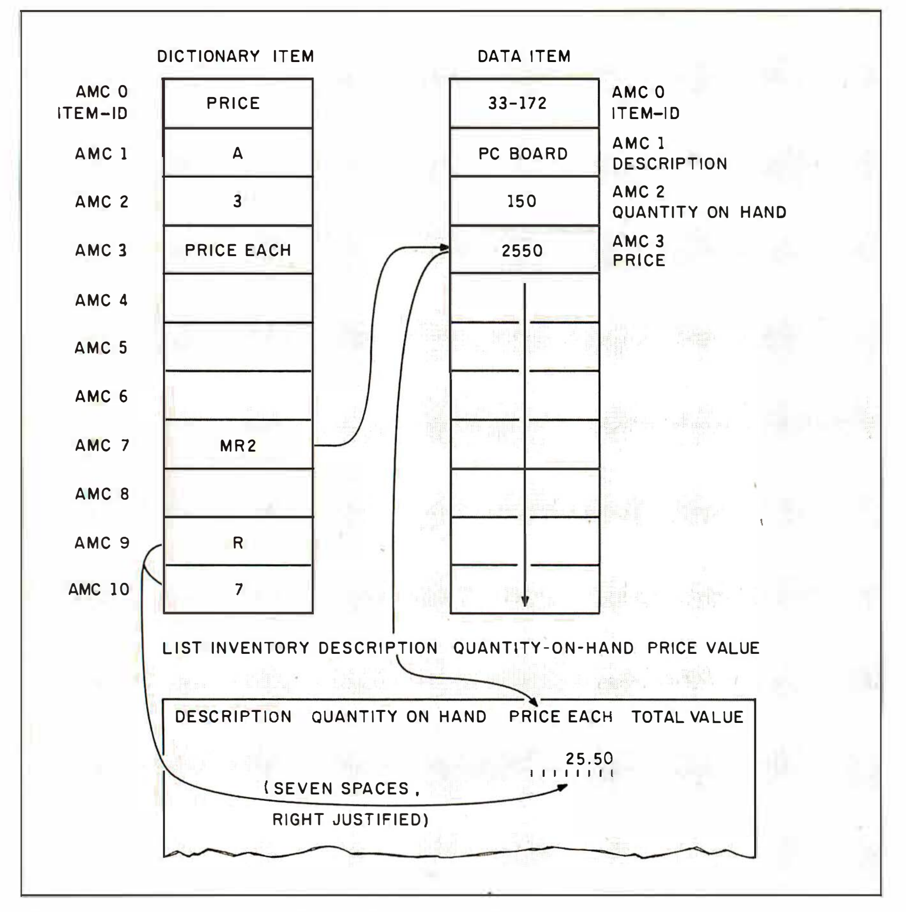


Figure 4: *Data dictionary item definitions. A dictionary item defining a data attribute consists of eight dictionary attributes, each with its own function. Note that dictionary attribute 7, the conversion attribute, specifies the form in which the data attribute will be displayed. In this case,* MR2 *converts 2550 into 25.50 for display purposes. The final two dictionary attributes specify that the item will be displayed right justified and will take up seven spaces on the screen or report.*

programs do it differently. For instance, many of them simply store the year as a two-digit number (i.e., 84). In these systems, dates are compared by subtracting one two-digit date from another one. Right now, these methods work, but in another 15 years, installations using them are going to face a nasty problem. The two-digit systems and the software written on them assume that the most recent year is the highest numbered. When they go from 1999 to 2000 that won't be true, and a lot of algorithms will fail. By storing its date internally as days since (or before) a given day, Pick avoids that problem.

The purpose of the conversion specification in DICT-ATT 7 is to tell the system how to convert the DATA-ATT before displaying or printing it. The list of available conversions that comes with Pick takes up several pages in the programmer's guide. Obviously, it would be much simpler to use a code in DICT-ATT 7 than to write a program to format or convert data.

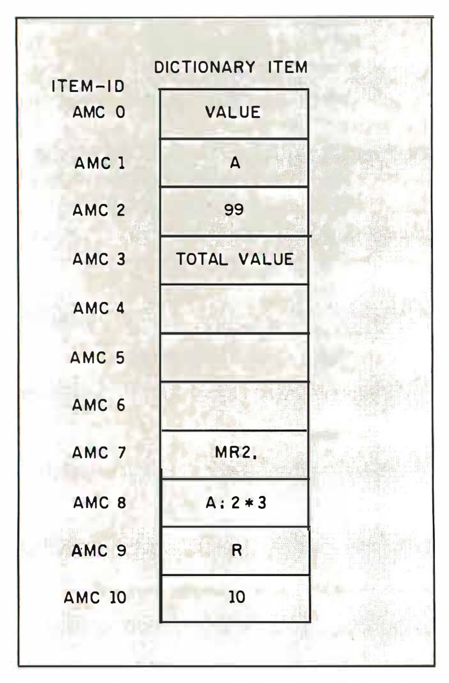


Figure 5: *A dictionary item defining a pseudoattribute.* VALUE *is calculated by multiplying the contents of data attributes 2 and 3, a process specified by the information in dictionary attribute 8. The* AMC *in dictionary attribute 3 is a dummy and is ignored by the system.*

In this example, DICT-ATT 7 is MR2. That tells the system to display the data with two decimal places.

DICT-ATT 8 is the correlative for this DATA-ATT. A correlative specifies some type of computation to be performed on the data before further processing.

DICT-ATT 9 gives information on justification. In this case, the DATA-ATT will be right justified when printed or displayed.

DICT-ATT 10 specifies that the DATA-ATT will be allotted seven spaces when it is printed or displayed.

As mentioned, a DICT-ATT doesn't have to represent an actual DATA-ATT. It can represent a pseudoattribute—a DATA-ATT that is calculated rather than stored.

Figure 5 shows a DICT-ITEM for such a DATA-ATT. There is no DATA-ATT in the data file for VALUE, which is defined as price times quantity on hand. However, it can be calculated.

The DICT-ITEM VALUE is the same as any other DICT-ITEM. The ITEM-ID is VALUE; it has an A in DICT-ATT 1 to indicate that it works with a DATA-ATT. The AMC, however, is arbitrary. Since it doesn't refer to an actual DATA-ATT, it can be 0 or 99 or any other number. The print heading is TOTAL VALUE. DICT-ATT 7, the conversion, indicates that the results are to be displayed with two decimal places and with commas between each group of three digits (as in the number 100,000,000.00).

The real change is in DICT-ATT 8. It indicates that this DATA-ATT is to be calculated as the product of DATA-ATT 2 times DATA-ATT 3. The remaining DICT-ATTs show the DATA-ATT is to be right justified and allowed 10 spaces on the display.

This kind of pseudoattribute is not limited to the data in a single item. It can return and use data stored in other files in the user's account—or even other accounts.

In these examples, we have just touched on the power of conversions and correlatives. The conversion and correlative routines are numerous and well chosen for information management in business.

The conversion and correlative routines are numerous and well chosen for business.

Other Dictionaries

Above the data dictionaries in the Pick hierarchy are master dictionaries, one for every user account on the system. A master dictionary contains the names and locations of the files belonging to the user. It also contains synonyms for files in this account and other user accounts, verb definitions for Access and other utilities, attribute-defining items for dictionaries below it, user-cataloged programs, and stored procedures. Like a data dictionary or any other Pick file, a master dictionary is composed of items and attributes. When you log onto Pick, you attach to a master dictionary. Unlike some operating systems, more than one user can be active on a master dictionary at once.

At the top of the tree is the system dictionary. Among other things, it includes the names of the user accounts and synonyms to the user accounts as well as the password and system privilege level for each user.

Next Month

In part 2, we'll take a close look at Pick BASIC, stored command sequences, terminal control features, and other Pick attributes. ■

ACKNOWLEDGMENT

The authors would like to thank Dennis Gallagher of Pick Systems Inc. for his assistance with this article.

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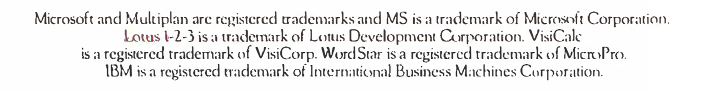
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ADDING A HARD DISK

BY ROY M. MATNEY

Kits, components, and expansions for the IBM PC

THE PRICE OF a hard disk for the IBM PC has dropped dramatically in the past few years—a Winchester drive is now within the means of the average owner. There are three ways to add a hard disk to your PC: buy an expansion chassis and disk from IBM, buy an add-on kit from another vendor, or install your own disk. Each method has advantages and drawbacks; you must balance cost against compatibility and power requirements.

Before you begin looking at hard disks, be sure your PC is equipped to handle a Winchester. Early PCs (the ones that have room for only 64K bytes of memory on the motherboard) will cause a problem. The BIOS (basic input/output system) will not check to see if other ROM (read-only memory) chips are in the system. This means that you cannot boot directly from the fixed disk. It also means that the controller won't work properly unless you install a different device driver.

IBM will sell you a new set of ROMs for your PC; they require you to return the originals when you buy the new ones. Once you have the new ROMs, all you have to do is plug them in. (IBM offers the 1501005 BIOS upgrade kit with a new set of ROMs to plug into the motherboard. Only IBM computer models 1, 13, 14, 64, and 74 require you to update the BIOS ROMs. Models 104, 114, 164, and 174 already have the necessary functions.)

DOS 2.0

Until IBM introduced DOS 2.0 in 1983, the PC lacked the software features to support hard disks. The directory was a one-dimensional array with a maximum of 64 to 112 files, depending on the type of disk drive. Under DOS 2.0, the directory is structured and can contain an unlimited number of files. Imagine trying to sort through 700 randomly arranged files, and you will appreciate the value of a well-defined mechanism to keep files organized.

DOS 2.0 contains several commands to support the hard disk. The BACKUP command backs up one or more files from a fixed disk to floppy disks. The RESTORE command rebuilds the fixed disk from floppies. The FDISK command initializes and configures the fixed disk.

Commands MKDIR, RMDIR, and CHDIR create, remove, and change directories, respectively. DOS 2.0 lets you define a main directory or subdirectory as the current one. The system works from this directory and normally doesn't need to refer to other directory nodes. This simplifies and speeds up the DOS's operation. It also helps you concentrate on a small area of the disk. The CHDIR command selects a new current directory. To allow program execution in subdirectories, DOS has a PATH command that lets it search other directories to find a file. The TREE command displays the specified disk's entire directory structure.

In addition to supporting its own fixed disk, IBM has a configuration file for adding another vendor's disk. It lets you replace existing drivers or add extra ones. The configuration file lists the drivers to be added.

COST

As manufacturers supplies increase and hard-disk technology matures, prices come down. Increased com-

(continued)

Roy M. Matney is an engineer with a "great interest in the IBM PC." He can be reached at 2911 Blue Lakes Lane, Missouri City, TX 77459.

Adding a hard disk to your system might overload the power supply.

petition and imports might drive prices still lower. You can now purchase a complete add-on kit for less than $900. If you buy the disk and the controller separately, the cost can be even lower. A 5-megabyte Winchester can cost less than $300, and a 10-megabyte disk could cost less than $400. Controllers for hard disks vary in price, starting at about $150 for some SASI (Shugart Associates System Interface) controllers. Prices for single-board controllers designed to plug into the PC start at around $295. IBM's 10-megabyte expansion chassis costs less than $3000.

When you compare the cost of one hard disk with another, consider speed; depending on your needs, a faster Winchester might be worth some additional expense. The speed of a fixed-disk system is largely determined by the time the head takes to get to the right track. Heads are positioned using either an open-loop positioner (similar to most floppy-disk drives) or a closed-loop servo system. The closed-loop servo system is newer, up to four times faster, more accurate, and more expensive. It also lets you store more data on each disk, since the tracks can be placed closer together.

STANDARDS

Most 5¼-inch fixed disks conform to the ST506 interface standard (named for the Seagate model ST506 disk) or a standard called ST412. The ST412 is much like the ST506 except that it supports buffered seek, which lets the heads move much faster over a long distance. The IBM controller supports both the ST506 and the ST412 standards. Two other standards, the ST412HP and ESDI (enhanced small disk interface) support even higher performance.

Within the ST506/412 standard, data is encoded using an MFM (modified frequency modulation) scheme. Data is transferred to the controller serially at 5 megabits per second, in contrast to a floppy speed of 250 kilobits per second. The control and data lines for the ST506/412 standard are shown in table 1. As long as you stick with an ST506- or ST412-compatible disk and controller you will not have to worry much about the signals between the controller and the disk.

You also need two ribbon cables: one 20-conductor cable for the data and one 34-conductor cable for control lines. They are both standard cables with one card-edge connector and one 100-mil center header connector.

Table 1: ST506/412 *interface signals.*

Control Signal	Pin
Reduced write current	2
Head select 2	4
Write gate	6
Seek complete	8
Track 000	10
Write fault	12
Head select 0	14
Reserved	16
Head select 1	18
Index	20
Ready	22
Step	24
Drive select 1	26
Drive select 2	28
Drive select 3	30
Drive select 4	32
Direction in	34
Ground	Odd pins

Data Signal	Pin
Drive selected	1
+MFM write data	13
-MFM write data	14
+MFM read data	17
-MFM read data	18

POWER REQUIREMENTS

A hard disk needs more power than a floppy disk. When you add a hard disk to your system, it is easy to overload the power supply. IBM rates its PC power supply at 5 volts for 7 amps, 12 volts at 2 amps. These are averages; IBM doesn't specify the peak current that you can pull out of the power supply. The power supply is protected for over- and under-voltages, as well as short circuits. If your power supply is overloaded, the system simply might not turn on. If you manage to squeak by with an almost overloaded system, a power supply running at its limit might have a much shorter than normal lifespan.

Let me demonstrate how easy it is to overload the PC's power supply. At 5 volts, the PC motherboard, including the keyboard, uses 1.6 amps. A monochrome or color graphics card display adapter draws 1.3 amps; a floppy-disk controller, 0.8 amp; and a hard-disk controller, 1.7 amps. A typical six-function board, memory, and I/O (input/output) draws 0.7 amp; a single floppy drive, 0.6 amp; and a standard size, 10-megabyte hard disk,

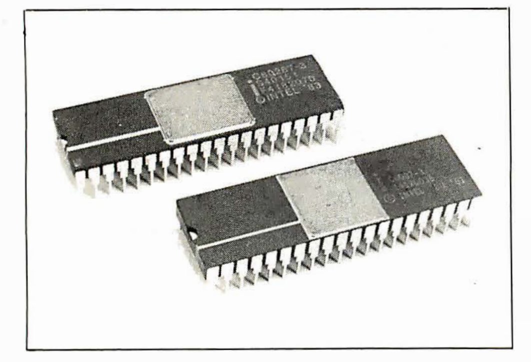
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about 1.5 amps. If you add up these typical system requirements, it is clear that the power supply is overloaded at the total—8.2 amps. This does not count the heavy load (about 4 amps) to power up the hard disk. Also, since you use only four slots in this configuration, the fifth slot is wasted.

The add-on manufacturers get around this problem by using half-height drives. The half-height drives take about half the power of a full-size drive and work in a PC if the other power requirements (such as multifunction boards) are not too high.

When you select a Winchester drive, look carefully at the power requirements. Most are power hungry. Even the half-height drives often require more power than the PC has available. Only a few half-height drives can be directly powered from the PC.

One solution would be an additional, external power supply. You can buy a small power supply that bolts onto the back of the PC chassis, just to power the Winchester.

CONTROLLERS

Several brands of controller cards are available. Prices vary from about $150 to $600, with IBM's at the top of the spectrum. Xebec (Sunnyvale, California), DTC (Santa Clara, California), Maynard (Casselberry, Florida) and Western Digital (Irvine, California) also manufacture controller cards.

The controller card's most important feature is compatibility with DOS 2.0. To be completely compatible, the controller card must use direct memory access (DMA) and must use the same DMA channel (3), interrupt address (5), and controller commands that IBM uses. Of the controllers mentioned above, only Xebec's is compatible at this level—Xebec also manufactures IBM's own controller cards. The commands for the Xebec controller are close, but not identical, to those of the IBM, so slightly different software is required. The controller available from Xebec is a two-board controller; a SASI board plugs into the PC and a cable runs to the second board. This board is the same size as the outline of the fixed disk and is usually mounted next to it.

The controllers manufactured by DTC, Western Digital, and Maynard are not compatible at the controller command level. They pick up their compatibility at the level of the BIOS routines. These controllers' calls to the BIOS look like IBM's (as listed in table 2). Any programs that attempt to address the hard disk at a level

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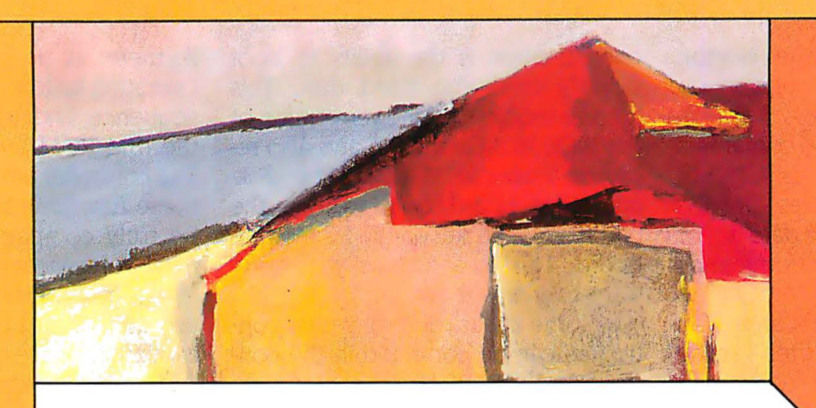
Table 2: IBM *controller commands.*

Command	Op Code
Test drive ready	00
Recalibrate	01
Request sense status	03
Format drive	04
Ready verify	05
Format track	06
Format bad track	07
Read	08
Write	0A
Seek	0B
Initialize drive characteristics	0C
Read ECC burst error length	0D
Read data from sector buffer	0E
Write data to sector buffer	0F
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lower than the BIOS (the Norton utilities, for example) will not work on these systems.

The controller typically contains a powerful processor such as a Z80 or a set of custom LSI devices. DMA is used to rapidly transfer data to or from memory. Controller commands such as READ or WRITE require no intervention by the 8088 after you issue them. Up to 64K bytes can be transferred by a single command. Each controller has its own unique command set, but the IBM controller's are typical.

Another important compatibility consideration is the ability to boot directly from the fixed disk. This feature requires the newer version of the BIOS ROM in the PC, and also requires a special ROM on the disk-controller board or placed in the empty ROM socket on the PC motherboard. This is a feature you won't want to live without.

In some cases, differences in controllers can be corrected in the controller's BIOS ROM. The IBM controller has a ROM in the PC memory space starting at location C8000. When the PC powers up, it looks to see if a valid ROM is at that location; if there is, it is bound into the operating system during the power-up sequence. The functions provided by the IBM ROM are shown in table 3. The controller and ROM must provide these functions for the fixed disk to be truly compatible. The IBM technical reference manual provides a listing of the IBM ROM that you can use as a model for developing your own BIOS.

The IBM controller is set up for several types of fixed disks. The disk parameters are specified in a table in the BIOS ROM. You can choose one of four disk types by changing jumpers on the controller board. If the parameters you need are not in the table, you can install a 2732 or 2532 EPROM in the board and modify the values as needed. The ROM space is 8K, but less than 2K is actually used.

If you do modify the table, remember to modify the checksum. A checksum is performed on the ROM during the power-up sequence and the fixed disk will not work if the checksum is wrong. A simple modulo 256 add generates the checksum.

Modifying the table lets you install a different disk in your system. IBM supplies only 10-megabyte units, but you can make yours as large as you want. See table 4 for the configuration table, along with the changes you need to make to use a 22-megabyte disk. Usually, you will not need to change more than a few entries in the table.

The first entry is the number of cylinders on your disk. (A cylinder is a collection of tracks, one from each disk surface, all the same distance from the disk axis. Imagine a cylinder that passes through track one in each of four stacked disks, for example.) The number of cylinders usually varies from manufacturer to manufacturer. The second entry is the number of heads. If you are installing a disk larger than 10 megabytes, this number will increase. The third entry tells the controller when to start using reduced write current. This information is usually supplied with the disk when you purchase it. The fourth

(continued)

Table 3: IBM *fixed-disk* BIOS *functions.*

Reset disk
Read status of last operation
Read sectors into memory
Write sectors from memory
Verify sectors
Format track
Format drive
Return drive parameters
Initialize drive parameters
Read long
Write long
Alternate reset
Read sector buffer
Write sector buffer
Test drive ready
Recalibrate
Controller RAM diagnostic
Drive diagnostic
Controller internal diagnostic

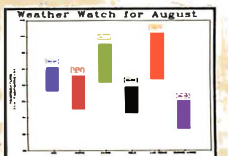
Table 4: *Disk configuration table.*

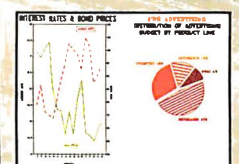
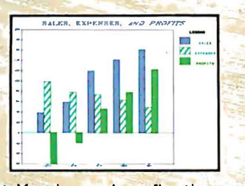
Parameter	Parameter Length Bytes	Value for 22 MB Decimal
Number of cylinders	2	320
Number of heads	1	8
Reduced write starting on cylinder #	2	132
Write precompensation starting cylinder #	2	0
Max ECC data burst length	1	13
Drive step option	1	5
Standard time out	1	12
Format time out	1	180
Check drive time out	1	40
Reserved	4	0

Chart-Master™ turns volumes of complex data into easy-to-understand graphics.

RATED NUMBER 1 BY SOFTWARE DIGEST!

"A picture is worth a thousand words." With this simple concept as a building block, Chart-Master is changing the way busy executives, analysts and secretaries look at, interpret and present information. In a fraction of the time required to wade through volumes of printouts, you can



Values printed at data points; both left and right Y-axis scales; floating legends & bars; both horizontal & vertical formats; exploded pie sections.

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Chart-Master supports the IBM Instruments XY750, Panasonic VP Series, Houston Instruments DMP29, Yokogawa PL1000 and Strobe plotters, in addition to the Hewlett-Packard family of plotters, for use with IBM PC and other compatible computers.

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DecisionResources
Software Designed for Decision Makers

Circle 99 on inquiry card.

entry tells where to start write precompensation. This is also supplied with the disk.

FORMATTING

If you buy your controller and disk separately, the disk will not be formatted. You must format it yourself—the DOS will not do it for you. If you use the IBM or Xebec controller, formatting is relatively easy. You can use the program in listing 1 to physically format the disk using the IBM controller. The formatting process writes the track number and sector identification on each track so the controller knows where to read and write data.

When initially formatted, the disk contains no data and has hexadecimal 6C written in each data location. To format the disk, you must create a data buffer containing 6Cs. You must tell the DMA controller where this buffer is located in memory. Three commands are issued to the controller. The first resets it, the second sets up the data buffer, and the third causes the entire disk to be formatted. This operation takes several minutes.

The next step is to run an IBM-

(continued)

Listing 1: *Fixed-disk format program.*

```
                              TITLE   HDFMT              ;HARD DISK
                                                          FORMAT

0000                          STACK   SEGMENT PARA STACK 'STACK'
0000      40 [                        DB 64 DUP ('STACK')
               53 54 41 43
               4B 20 20 20
                            ]
0200                          STACK   ENDS
0000                          WORK    SEGMENT PARA PUBLIC 'WORK'
0000  0400  [                 FILL    DB 1024 DUP(6CH)
               6C
                  ]
0400  24                              DB '$'
0401                          WORK    ENDS
0000                          SOFT    SEGMENT PARA PUBLIC 'SOFT'
0000  ??                      LOC     DB ?
0001                          SOFT    ENDS
0000                          CSEG    SEGMENT PARA PUBLIC 'CODE'
0000                          START   PROC FAR
                                      ASSUME CS:CSEG,DS:WORK,SS:
                                      STACK,ES:SOFT
0000  B8   0000                       MOV AX,0
0003  1E                              PUSH DS
0004  50                              PUSH AX
0005  B8   ----------- R              MOV AX,WORK
0008  8E   D8                         MOV DS,AX
000A  8E   C0                         MOV ES,AX          ;DMA LOCATION
000C  B0   06                         MOV AL,6           ;INTERLEAVE=6
000E  B4   00                         MOV AH,0           ;RESET
0010  B9   0001                       MOV CX,1           ;CYL=0
                                                          SECTOR=1
0013  BB   0000  R                    MOV BX,OFFSET FILL ;DMA OFFSET
0016  BA   0080                       MOV DX,80H         ;HEAD=0 DR=0
0019  CD   13                         INT 13H            ;RESET DISK
001B  B8   0F01                       MOV AX,0F01H       ;LOAD BUFFER
001E  CD   13                         INT 13H
0020  B8   0701                       MOV AX,701H        ;FORMAT
0023  CD   13                         INT 13H
0025  CB                              RET                ;RETURN TO DOS
0026                          START   ENDP
0026                          CSEG    ENDS
                                      END START
```

Dear Smith-Corona,

Imagine sending an m ortant letter printed on a dot matrix printer.

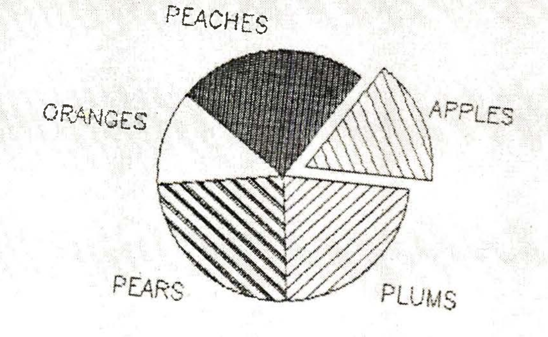
"Impossible," I would have said before. "Impeccable," I say, now that I've bought your new dot matrix.

A dot that has two kinds of printout (graphics and text) for very little shell-out. That's impressive. And so very practical. A "two-in-one" fast dot. One that does everything I used to use two to do.

I was going to call you to congratulate you on your ingenious dot. But then I thought, and decided a letter would be more perfect.

Thank you.

Ron Rosenfeld
Co-Chairman
Rosenfeld, Sirowitz & Lawson



At last, dot plus dash for very little cash.

The dot matrix printer with superb letter quality plus high-speed graphics. For under $800.



Besides all the super high-speed graphics you expect, what else can you do with the Smith-Corona dual-interface D-200 dot matrix printer? You can print at a speed of 120 CPS (that's dash), with 80 characters per line. And you can write with quality. You can even use computer paper or letterhead with a removable tractor feed, which comes as standard equipment.

You can italicize to make a point. Emphasize to point out a good idea. Emphasize and italicize to make a point about a good idea. Enlarge if it's a big idea. Then subscript or superscript to make it all add up.

It's easy to see why so many people think a Smith-Corona printer is the one and only dot.



Circle 324 on inquiry card.

Once you install a hard disk in your PC, consider its care and maintenance.

supplied program, FDISK, that lets you divide the disk into partitions to use several operating systems. FDISK lets you run one operating system on one part of the disk and another somewhere else, up to four divisions. FDISK asks how much of the disk to allot to each operating system.

After running FDISK, you must issue the DOS FORMAT command. FORMAT checks the surface of the disk, sets up the directory and file allocation table for DOS, and copies the bootstrap and system onto the first track.

If this formatting sequence is not successfully completed, one of the disk installation programs might tell you that your hard disk is not usable. Don't panic. This is not necessarily a problem with the disk—it might be a problem with formatting.

The fixed disk will automatically be assigned the next drive letter after any floppies and electronic drives. This will automatically change if you change the number of floppies in the system, so you don't have to worry about conflicts due to system reconfiguration. You can move new versions of DOS (such as 2.1) onto the fixed disk using the SYSTEM command. You do not have to reformat.

Hard-Disk Care

Once you have a hard disk installed in your PC, give some thought to its care and maintenance. The hard disk's heads and surfaces are quite delicate—moving the unit around can damage them.

When the disk is running, the heads ride on a very thin cushion of air. They are extremely close to the disk surface and actually sit on it when stopped. Don't turn the power on and off with the heads over the outer track where the directory and file allocation segments are stored, since damage there could render the disk useless. Each time you turn the power off, you should move the heads to the center of the disk. This is extremely important when you plan to physically move the drive.

Listing 2 is a program to move the heads to the inside track. The program first sets up the DMA channel, then issues a SEEK command to the controller. The SEEK command specifies the innermost track.

Dust on a disk surface could cause damage, so hard disks are assembled in clean rooms and are heavily filtered. Still, no filter is perfect, so it is better not to smoke or stir up dust around your disk.

Conclusion

There are cost advantages in assembling your hard disk from different sources, especially for the higher-capacity disks. If you have experience in modifying your system, you might want to try it. If not, the expansion chassis from IBM or a kit from another vendor might be the best solution to your disk storage problems.

Whichever method you choose, you will soon find that the hard disk is indispensable. ■

Listing 2: *Park fixed-disk heads program.*

```
                        TITLE   STOP                    ;HD POWER OFF
                                                        PROG

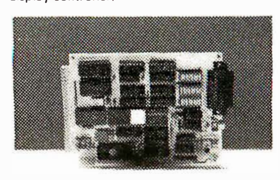
                        ;       THIS PROGRAM MOVES THE HARD
                                DISK
                        ;       HEAD TO CYL 320 BEFORE POWER
                                DOWN
                        ;
0000                    STACK   SEGMENT PARA STACK 'STACK'
0000  40 [                      DB 64 DUP('STACK')
           53 54 41 43
           4B 20 20 20
                      ]
0200                    STACK   ENDS
0000                    WORK    SEGMENT PARA PUBLIC 'WORK'
0000  24                        DB '$'
0001                    WORK    ENDS
0000                    SOFT    SEGMENT PARA PUBLIC 'SOFT'
0000  ??                LOC     DB ?
0001                    SOFT    ENDS
0000                    CSEG    SEGMENT PARA PUBLIC 'CODE'
0000                    START   PROC FAR
                                ASSUME CS:CSEG,DS:WORK,SS:
                                STACK,ES:SOFT
0000  B8   0000                 MOV AX,0
0003  1E                        PUSH DS
0004  50                        PUSH AX
0005  B8   ---------- R         MOV AX,WORK
0008  8E   D8                   MOV DS,AX
000A  8E   C0                   MOV ES,AX               ;DMA LOCATION
000C  B8   0C01                 MOV AX,0C01H            ;SEEK COMMAND
000F  B9   3F41                 MOV CX,3F41H            ;CYL=320
                                                        SECTOR=1
0012  BB   0000                 MOV BX,0                ;DMA OFFSET
0015  BA   0080                 MOV DX,80H              ;HEAD=0 DR=0
0018  CD   13                   INT 13H                 ;CMD DISK
001A  CB                        RET                     ;RETURN TO DOS
001B                    START   ENDP
001B                    CSEG    ENDS
                                END START
```

Circle 409 on inquiry card.

The Micromint Collection

TERM-MITE ST SMART TERMINAL BOARD

TERM-MITE is a completely self-contained video display controller.



All you need to build a Smart Video Terminal equivalent to the types advertised for $1000 or more is a Term-Mite ST circuit board, scanned or parallel keyboard, video monitor and power supply.

- Uses brand new Nat'l Semi NS405 Terminal Processor.
- 24 lines by 80 characters, 25th reverse-video status.
- Upper & lowercase. Line (block) graphics.
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- Reverse video, half intensity, double height & width, underline, blinking and/or blank character.
- Separate sync or composite video output. Self Test.

TERM-MITE ST Video Display Terminal Board
BCC22 Assembled & Tested .... $284.
BCC23 Complete Kit .... $244.

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As featured on the cover of BYTE Magazine. Also featured in Ciarcia's Circuit Cellar November, December 1982 & January 1983

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- Use it as an IBM PC look alike that directly boots PC DOS 2.0 and accepts all expansion boards designed for the IBM PC.
- Use it as a powerful 8088 single board computer for all your OEM applications. Just add serial terminal, disk drive and power supply. Directly boots CP/M-86.

Buy the MPX-16 in the form that best meets your needs or budget. As a bare board, as a wave soldered board that contains all components less ICs, as an assembled and tested circuit board or as a complete system.

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- IBM PC bus compatible +9 expansion slots.
- Intel 8088 16-bit microprocessor.
- Optional Intel 8087 math cocprocessor.
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- Up to one megabyte of system memory.
- Up to 64K bytes of system ROM/EPROM.
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- Sixteen levels of vectored interrupts.

MPX-16 Circuit Board Assembled w/64K RAM .... $1,200.
OEM 100 quantity price .... 840.
MPX-16 Circuit Board Assembled w/256K RAM .... 1,400.
MPX-16 Semi-Kit (wave soldered circuit board w/all components) Less ICs .... 595.
Complete Kit of ICs w/256K RAM .... 595.
MPX-16 Unpopulated (bare) PC Board .... 300.
CP/M-86 Operating System + Manuals ..... 80.
MPX-16 Switching Power Supply .... 300.
MPX-16 Technical Reference Manual ...... 50.
MPX-16 Metal Enclosure with Fan .... 225.
Tandon TM 100-2 Double Sided/Density Drive .... 300.
IBM/PC Keyboard Interface Adapter ..... 100.

Shipping and handling additional on MPX-16 orders.

Circle 230 on inquiry card.

Z8 COMPUTER SYSTEM

BASIC System Controller



The Z8 Basic System Controller is an updated version of our popular BCC01. The price has been reduced and features added. The entire computer is 4" by 4¼" and includes a tiny BASIC interpreter, up to 6K bytes of RAM and EPROM, one RS-232C serial port with switchable baud rates and two parallel ports. BASIC or machine language programming is accomplished simply by connecting a CRT terminal. Programs can be transferred to 2732 EPROMs with an optional EPROM programmer for auto start applications. Additional Z8 peripheral boards include memory expansion, serial and parallel I/O, real time clock, an A/D Converter and an EPROM programmer.

- Uses Zilog Z8 single chip microprocessor.
- Data and address buses available for complete peripheral expansion
- Can be battery operated.
- Cross assemblers for various computers.

BCC11 Assembled & Tested .... $149. New Low Price

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With the new Z8 with on board 4K FORTH you can program high speed control functions in a few simple high level language commands. Perfect for data reduction, process control and high speed control applications.

BCC20 Z8F FORTH Microprocessor chip . $150.
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- 8K bytes of additional RAM or EPROM.
- Three additional 8 bit parallel ports.
- Cassette interface — 300 baud K.C. Standard.
- Software real time clock.

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- Comes with programming & utility routines on EPROM.
- Requires Z8 I/O Expansion Board for operation.

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- Uses Analog Devices 7581 IC, 8-channel 8-bit.
- Adds process control capability to the Z8 system
- Over 1,000 conversions per channel per second.
- Monitors 8 analog signals in one of two 10v Ranges.

BCC13 Assembled & Tested .... $140.

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- Adds additional RS-232C and opto-isolated 20 ma. current loop serial port to the Z8 System.
- Runs at 75 to 19,200 baud in all protocols.
- Comes with listings of sample serial I/O routines.

BCC08 Assembled & Tested .... $160.

16K Memory Expansion Board

- Add up to 16K of additional memory, RAM or EPROM, to your Z8 System Controller in any multiple.
- Accepts 2016, 6116, 2716, or 2732 memory types.
- Four 16K cards may be installed on the Z8 System bringing the total memory to 64K.

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IBM PC, APPLE, 6502 Systems 5¼", CP/M 2.2 8" .... $75.
From Allen Ashley
TRS-80 Model I, III, Northstar 5¼" .... 75.
CP/M 2.2 8" .... 150.

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- Expand your Z8 BASIC System with minimum effort.
- Contains five slots complete w/44 pin connectors.

MB02 Assembled & Tested .... $69.

Triple Voltage Power Supplies

+5V @ 300 ma. +/- 12V @ 25 ma.
UPS01 Assembled & Tested .... $35.
UPS02 Complete Kit .... 27.
+5V @ 1 Amp. +12V @ .5 Amp. -12V @ 50 ma.
UPS03 Assembled & Tested .... 60.
UPS04 Complete Kit .... 50.

SPEECH PRODUCTS

Lis' ner 1000 Voice Recognition Board



Uses the new, high performance SP1000 voice recognition chip.

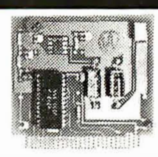
The LIS' NER 1000 provides voice input capability for your computer. The unit functions in the same manner as your keyboard, serving as a data entry device for application programs or the normal operation of the computer.

The LIS' NER 1000 recognition system works by analyzing human speech and extracting the most important features. These impressions of words are compacted into "templates" which can be stored and later compared to someone talking to the recognition unit. The LIS' NER 1000 supports a 64 word vocabulary in speaker dependent, discrete utterance mode. The recognition accuracy is greater than 98%. Each unit comes with a professional quality head-band style electret microphone to assure accuracy, software on diskette and a user's manual.

The APPLE II LIS' NER board has provision for an SSI 263 phonetic speech synthesizer chip with text-to-speech algorithm. This addition provides all the features described for the Sweet Talker II as well as speech recognition.

APPLE II LIS' NER 1000 with SP1000 recognition/synthesis components only
VR01 Assembled & Tested .... $189.
VR02 Complete Kit .... $149.
APPLE II LIS' NER 1000 with SP1000 recognition/synthesis components and SSI 263 phoneme synthesizer chip with text to speech algorithm.
VR03 Assembled and Tested .... $259.
VR04 Complete Kit .... $219.
COMMODORE 64 LIS' NER 1000 with SP1000 recognition/synthesis components
VR10 Assembled & Tested .... $149.
VR11 Complete Kit .... $119.

Sweet Talker II Text-to-Speech Synthesizer

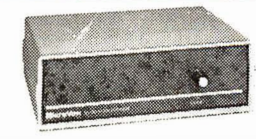


SWEET TALKER II, a 3rd generation speech synthesizer, is based on the SSI 263. SWEET TALKER II directly drives a speaker to provide music, sound effects and continuous speech of unlimited vocabulary at data rates as low as 50-70 bps.

- SSI 263-based Apple II compatible speech synthesis board
- Comes with text-to-speech algorithm on disk (DOS 3.3)
- Appropriate control inputs for mapping with several buses
- On-board 1 watt amplifier with volume control
- Measures 3" x 3¼"
- Operates on +5 and +12v

ST22 SWEET TALKER II Apple II compatible speech synthesizer with text-to-speech algorithm on disk .... $104.

Microvox Text-to-Speech Synthesizer



Microvox is a professional voice quality text- to speech synthesizer that is easily interfaced to any computer, modem, RS-232C serial or parallel output device and provides speech of unbelievable clarity.

- Unlimited vocabulary.
- 64 programmable inflection levels.
- 6K text-to-speech algorithm.
- Full ASCII character set recognition and echo.
- RS232C and parallel input.
- 1000 Character buffer, 3000 optional.
- Adjustable baud rates (75-9600).
- Spelling output mode.
- 7 octave music and sound effects.
- On board audio amplifier & power supply.
- X-On/X-Off handshaking.

MV01 Assembled with 1K buffer .... $349.
MV02 Complete Kit with 1K buffer ..... $269.
Add $15.00 for 3K buffer option.

Speech Synthesizer IC's

The SC-01A Speech Synthesizer is a completely self-contained solid state device that phonetically synthesizes continuous speech of unlimited vocabulary.

SC01A Quantity 1-99 .... $32.
100+ .... $24.
1000+ .... call

The Silicon Systems SSI 263 Speech Synthesizer Chip is a third generation speech synthesizer chip that produces even more intelligible speech than did older devices. The SSI 263 has improved intonation, inflection and filtration.

SSI 263 Quantity 1-9 .... $42. ea.
10-99 .... $34. ea.
100 .... $30. ea.

The Micromint is stocking thousands of SP1000 voice recognition chips. Call us for a quote.

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- Software includes utilities for auto exposure, multi-level greyscale, screen dump and image enhancement.
- Includes interface card, 4 foot extension cable camera assembly, manual, and software on diskette.

DC01 IBM PC Assembled & Tested ...... $299.
DC02 IBM PC Complete Kit .... $264.
DC03 APPLE II Assembled & Tested .... $299.
DC04 APPLE II Complete Kit .... $264.

ULTRASONIC RANGING SYSTE[M]

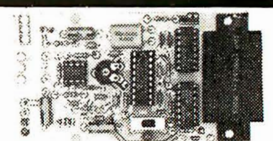
The Micromint Sonar Ranging Experimenter's Kit is an updated and higher functioning version of the Polaroid SX-70 Camera sonar ranging circuit used in the original Polaroid Ultrasonic Ranging System Designer's Kit. There are similar performance characteristics but this unit requires far less support circuitry and interface hardware.

The TI ranging module can function between 4.5 and 6.8v. With a 5v supply, the ranging module I/O is TTL compatible and can be connected directly to most computers with one input and one output bit.

The Sonar Ranging Experimenter's Kit includes one SN28827 ranging module, one Polaroid 50 KHz electrostatic transducer, and user's manual with data sheets.

TI01 Sonar Ranging Experimenters Kit ... $60.

300 BAUD ANSWER/ ORIGINATE MODEM KIT



Micromint's latest 300 Baud Modem Kit is crystal controlled, uses the TI TMS99532 IC, contains just 25 parts and requires no calibration or adjustments. Use with acoustic coupler or in direct connect mode.

MD04 Complete Kit as shown .... $60.
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For Information Call: 1-516-374-6793
Call: Monday-Friday, 9-5 PM



OPTICAL MEMORY: DATA STORAGE BY LASER

BY EDWARD S. ROTHCHILD

Erasable media may soon be available

AFTER MORE THAN 12 years of research and development in laboratories in the United States, Europe, and Japan, optical-memory drives and media are finally being shipped to customers. Optical-memory storage, the laser writing and reading of information on sensitive removable media in the user's drive, is a spinoff of laser videodisc technology. However, perfecting digital read/write optical-memory systems has posed greater technical problems than analog read-only videodisc or digital read-only compact disk systems. These problems include developing optical media sensitive enough to be marked at high data rates with low-power lasers and maintaining almost error-free data at acceptable computer industry standards for at least 10 years, or no more than one uncorrectable error in 10^{12} (one trillion) bits.

In reviewing optical-storage developments since my last article appeared ("Optical-Memory Media" March 1983 BYTE, page 86), the most significant trend emerging is the realization that the spectacular success of 5¼-inch and smaller rigid and flexible magnetic disk drives and media could be duplicated in small, low-cost, read/write and read-only removable-disk, optical-storage products. This trend also occurred to people wrestling with the problems associated with making high-density magnetic recording work with rigid disks. We might call 1984 "The Year of the Small Disk." The concept of a 2-inch optical disk and drive was proposed at a scientific conference at Lake Tahoe, Nevada, in January 1983 by Dr. Ingolf Sander, now with Verbatim in Sunnyvale, California. He described a 2-inch drive with 10 to 20 megabytes of user capacity using magneto-optic erasable techniques, which could be sold for the cost of a micro-Winchester drive.

All optical drives introduced to date use nonerasable media. Although you can add information to unrecorded areas of the disk and obliterate information already recorded, you cannot erase and update data in place as with magnetic media. The lack of erasability is actually an advantage in many applications; with so much user capacity on removable optical disks, you can simply put a disabling code in a sector containing obsolete data and a pointer to new data recorded elsewhere on the disk. This feature permits reconstruction of an audit trail at a later date, which would be impossible with media that are updated in place.

Despite the advantages of permanent, tamperproof, write-once disks, many applications call for the "update in place" capability of erasable media. Coupling erasability with the random-accessibility of rigid magnetic disks and the removability of magnetic tape makes erasable, high-capacity, low-cost optical media ideal for storage. Erasable optical disks have been demonstrated mainly using two different types of techniques, magneto-optic

(continued)

Edward S. Rothchild (POB 14817, San Francisco, CA 94114) is chairman of Rothchild Consultants, a firm specializing in offering consulting services, conferences, and research studies in optical memory, interactive videodisc, and compact-disk technologies. He is also editor and publisher of the bimonthly journal Optical Memory News *and the annual* Optical Memory Report.

and crystalline-to-amorphous phase change.

Magneto-Optic Technology

In magneto-optic recording (figure 1), a process similar to vertical magnetic recording (see "The Promise of Perpendicular Magnetic Recording," March 1983 BYTE, page 56), a laser beam is used to temporarily reduce the magnetic medium's coercivity, i.e., render it more susceptible to a change in its magnetic charge. The recording materials that are used most frequently are terbium and iron, sometimes alloyed with gadolinium or bismuth. The typical magneto-optic head has a coil wrapped around the lens. This coil produces a field of moderate strength (typically 100 to 600 oersteds) over a large area centered on the lens axis. This field is perpendicular to the medium; a magnetic plate is frequently placed on the far side of the medium to maintain that orientation. The applied field is not strong enough to affect the medium unless that medium is heated to near its Curie temperature (the point at which the coercivity is zero and the medium is most susceptible to magnetic change). This is the job of the laser beam, which supplies both energy and localization for the writing process.

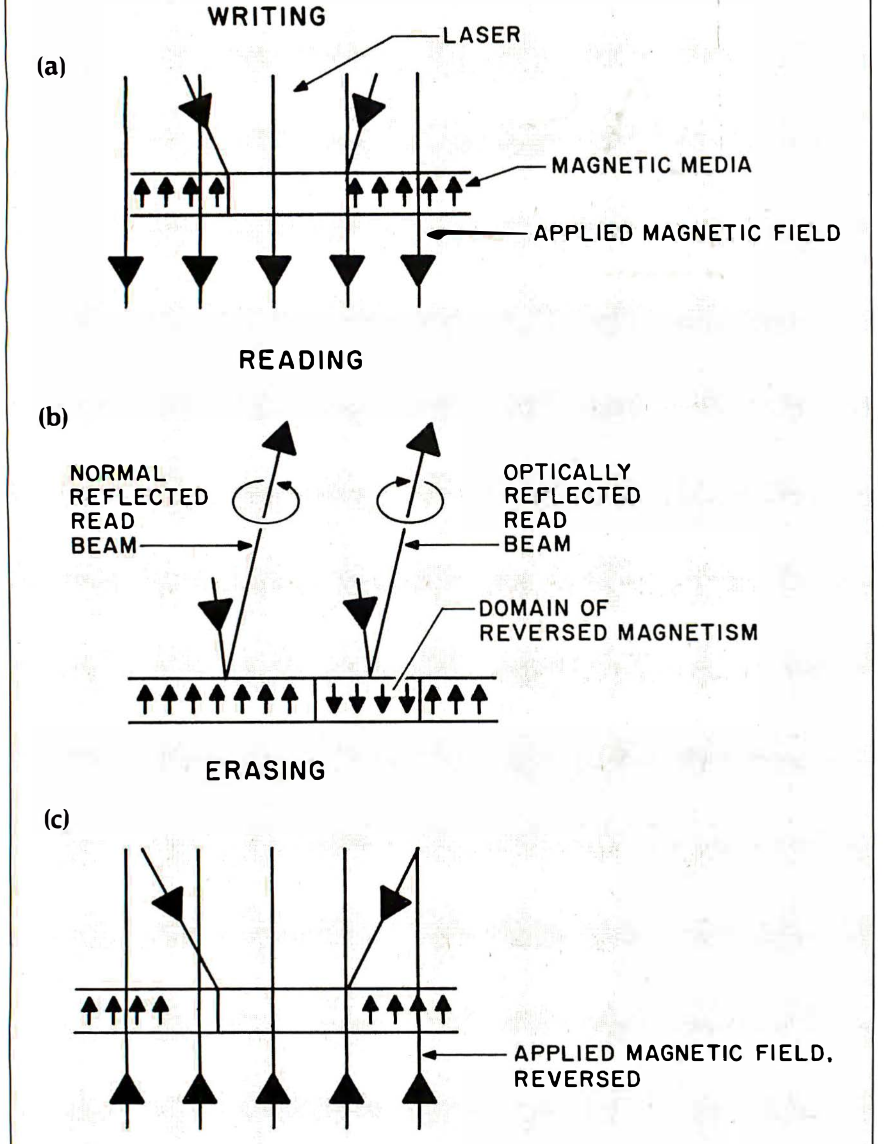


Figure 1: (a) *In magneto-optic recording, a magnetic field applied to the medium is not strong enough to affect it until it is heated with a laser beam.* (b) *A domain of reversed magnetism is formed, which rotates the plane of reflected light* (Kerr effect) *differently than unswitched regions of media.* (c) *Erasure and rewriting is accomplished by reversal of the magnetic field.* (Courtesy of Alan Bell, IBM Research Division, San Jose, CA.)

Reading is done via either the Kerr or the Faraday effect, both based on the rotation of the plane of polarized light when it is passed through a magnetized material. Typical rotations of polarized light range from 0.3 degree for simple single-layer media to 9 degrees for multilayer structures. Reading contrast (i.e., the sharpness of the recorded marks) on such erasable media is not as high as with write-once media; achieving a good signal-to-noise ratio requires a fairly strong laser read beam, but the power must be kept below that which affects previous writing. Still, carrier-to-noise ratios over 50 decibels (dB) have been achieved. Erasure and rewriting follows the procedure for writing, but with the applied field reversed.

Phase-Change Media

One of 1983's most notable events was the public demonstration in New York by Matsushita of its Panasonic erasable optical videodisc and drive, which employs the crystalline-to-amorphous phase-change technique (figure 2). The sensitive layer of the disk is made of tellurium suboxide alloyed with small amounts of germanium, indium, and lead. In the read/write process, this crystalline phase, which has high reflectivity, is converted into an amorphous phase of low reflectivity; the reverse occurs during erasing. Writing and reading are done with an 830-nanometer laser, writing at 8 milliwatts of power

(continued)

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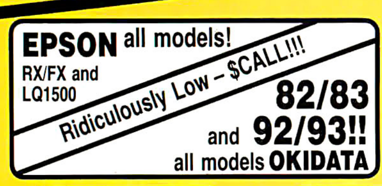
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IBM may be close to releasing a read-only optical-disk that holds 40 mb of software.

and reading at 1 milliwatt. Erasing is done at 780 nanometers with 10 milliwatts of incident laser power, creating a spot 1 by 10 microns in size, small enough to allow almost simultaneous erasing and recording with a single focusing lens. Matsushita claims over 1 million erase cycles (erasing and rewriting a million times) have been achieved with its disk, which spins at 1800 revolutions per minute (rpm). When in mass production in several years, Matsushita expects its 8-inch erasable disk to retail for $30, with the write-once disk selling for $20. The Panasonic digital data erasable drive and media with 700 megabytes of user capacity on one disk side will be introduced by Matsushita in the spring of 1985.

Phase-change media do not require as complicated a drive as magneto-optics, and they permit nonalterable recording by increasing laser power to the point of permanently burning holes in the recording layer rather than simply changing its phase. Recently, several erasable polymer/dye binder media have been shown that offer the simplicity of drive design of phase-change media, but are producible at lower cost without using toxic materials such as tellurium, selenium, and arsenic.

Compact-Disk Technology

In the spring of 1983, compact-disk (digital-audio) players from Sony went on sale in the United States at a list price of $900. By October of that year, 20 brands of players were on sale and list prices had dropped to $400, less than half the price of the first models a year earlier. This is rare with a new consumer product. The spectacular success of compact-disk players enabled makers of critical components to build up such large inventories that the price of integrated optical heads dropped to about $40. This year, they are expected to drop to $20, making a $200 player possible, the price at which retailers expect massive product acceptance. Over 500,000 players and 10 million disks were sold worldwide in 1983, making the compact disk the most successful new electronic product ever introduced.

Digital-data versions of compact-disk players will be on sale as small-computer peripherals this year, called either OROM (optical read-only memory) or CD-ROM (compact-disk read-only memory). N.V. Philips and Sony, codevelopers of the compact disk, are supporting a standard for putting 550 megabytes of user data on a replicated 4.72-inch (12-cm) disk that transfers data at 1.44 megabits per second. (An entire replicated disk is stamped from a master disk, similar to the way records are made—as opposed to copying information bit by bit, as in floppy-disk reproduction.) IBM is believed to be close to releasing a read-only replicated optical-disk system with a smaller, faster format—possibly as small as 2 inches—containing 40 megabytes of information, including the UNIX operating system, application software, and various databases.

The compact disk has done for optical-disk-drive developers what they had expected the slower-selling optical videodisc players to do: dramatically lower the cost of lasers, tracking and servo mechanisms. Accordingly, several firms have announced plans to build very low cost read/write optical drives, using as many components as possible common to compact-disk players and magnetic-disk drives. Developers are taking this strategy of producing drives and disks at relaxed technological levels before pushing for maximum capacity and performance.

An example of this strategy is Information Storage Inc. in Colorado Springs, Colorado, which has announced plans to introduce a 5¼-inch write-once optical drive in the spring of 1985 at original equipment manufacturers (OEMs) prices below $800. The first drive product will have 150 megabytes of user data, less than one-third the capacity possible. Erasable drives are expected about one year later.

At the Tokyo Business Show in May

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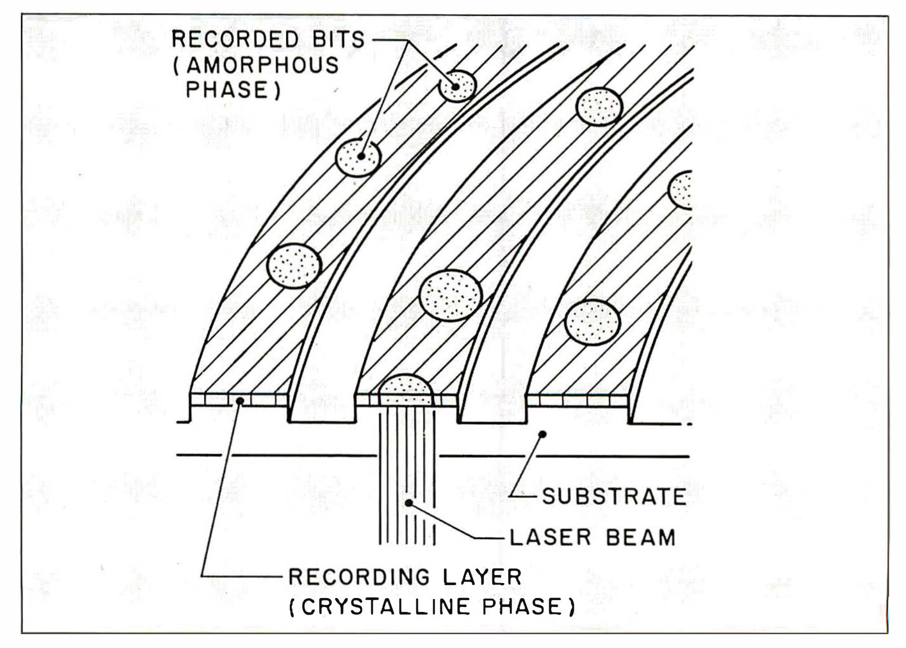


Figure 2: *Phase-change recording involves the transition of media from a high-reflectivity (crystalline) phase to a low-reflectivity (amorphous) phase.*

1983, Hitachi, Matsushita, NEC, Sanyo, Sharp, Sony, and Toshiba showed complete optical-disk document-storage systems. At the National Computer Conference in Anaheim, California, that month, NEC showed its drive, and an Optical Peripherals Laboratory drive was shown by Control Data. All of these drives are designed to be controlled by a minicomputer or supermicrocomputer. Most use 12-inch disks with user capacity over 1000 megabytes on a side; several double-sided disks are already available.

FUTURE DIRECTIONS

Among the 79 papers at the huge optical-memory conference held in June 1983 in Arlington, Virginia, were several that indicated possible future directions the technology might take: stacks of small optical disks spinning at very high rpm to achieve high data rates; polymer/dye binder media for high packing density (the number of bits that can be handled per inch of media) and low manufacturing cost, leading to optical floppy disks; and a variety of materials for erasable media including: combinations of terbium, iron, gadolinium, cobalt, and dysprosium; tellurium alloys; liquid crystal; vanadium dioxide; yttrium indium garnet; and photochromic and photodichroic materials (whose optical characteristics change upon exposure to radiant energy).

Last summer, I had the opportunity to visit nine research and development facilities in Japan as part of an international study of optical disk drive and media projects. Perhaps the most significant insight into the near-term viability of optical storage came from Professor Shinichi Iwasaki of Tohoku University, one of the world's most highly regarded authorities on high-density, vertical magnetic recording. It is Dr. Iwasaki's opinion that vertical magnetic recording is most suited to lower-capacity flexible disks and tape, not rigid disks, and that the head design must be changed for rigid-disk vertical recording. According to Dr. Iwasaki, higher flying heights are possible with perpendicular than with longitudinal recording, but vertical magnetic media production is currently limited by the technology for deposition of thin-film recording media on a substrate, known as sputtering. He indicated that it may be possible to produce vertical media with vacuum evaporation, another thin-film deposition technique.

Professor Iwasaki feels that vertical magnetic recording is much easier to accomplish than magneto-optic recording, but mass production of vertical magnetic media awaits improvement in vacuum deposition, which he



thinks will take several years. The problems associated with perfecting such high-density, high-capacity rigid magnetic media indicated that a window of opportunity has been opened for optical-memory developers, during which optical storage can take hold without fear of serious competition from high-density magnetics.

Furthermore, even if vertical or other high-density magnetic recording techniques are perfected for rigid-disk applications, researchers will still have to cope with their most serious drawbacks compared with optical recording: they are not removable and should be backed up, requiring additional hardware, media, space, personnel, and cost.

A milestone occurred at the by-invitation-only September 1983 meeting at Lake Arrowhead, California, where U.S. magnetic-industry gurus admitted privately that serious problems exist in making rigid vertical magnetic media work, and that magneto-optic media look promising. It was said that small low-cost magneto-optic drives might experience tremendous growth similar to micro-Winchester drives.

One sign of the concession to magneto-optic technology was the suggestion by Leonard J. Laub, president of Vision Three consulting firm, that the technology be dubbed "optically assisted magnetic recording"—a term that both camps readily endorsed.

Vertical magnetic media are not removable and should be backed up.

PRODUCT INTRODUCTIONS

Storage Technology Corporation (STC) on September 20, 1983, became the first to introduce an optical disk drive and media for mainframe computer users. Although its drive subsystem is priced high at $130,000 for the drive and $40,000 to $70,000 for the controller (depending on its configuration), STC's 14-inch write-once phase-change disk with 4000 megabytes of user capacity is priced at $140 to quantity buyers. This drops the cost per stored megabyte to five cents, much lower than any magnetic media.

Also in late September, KDD and Sony announced joint development of a magneto-optic erasable disk using a terbium-iron-cobalt material that yields over 52 dB carrier-to-noise ratio at 1 megahertz. The disks are designed for digital and analog uses including continuous-motion (as opposed to still-frame) video recording.

(continued)

Products using the disks are due in 1985. The performance of the disk is considered by those familiar with it to be among the best developed to date.

Optimem introduced its drive on October 10, 1983, using gold-platinum alloy write-once media supplied by the French firm, Thomson-CSF. The Optimem drive has a user capacity of 1000 megabytes and is aimed at mini- and supermicrocomputer OEM digital and image applications, especially documented storage and retrieval. Optimem, a division of Xerox's Shugart Associates, is offering the first medium-priced American optical drive to OEMs at $6000 to $9000. Thomson-CSF introduced its drive and media in Paris on November 17, 1983, aimed at the same users as Optimem.

At the 1983 Data Show in Tokyo, Canon and Hitachi each introduced complete optical-disk-based document-storage systems. To date, Canon has shown the most comprehensive and cost-effective optical-disk-based system. Canon's system integrates micrographic, magnetic, and optical storage systems under one controller, and includes very high resolution scanning, display, laser printing, and telecommunications. The system goes on sale in Japan in late 1984 at about $40,000, or about half the price of other electronic filing systems with similar features. Both Hitachi's and Canon's drives can be used for digital-data applications, as they correct errors to 10^{-12} (one every 10^{12} bits), the maximum hard error (corrected) rate tolerable to the computer industry.

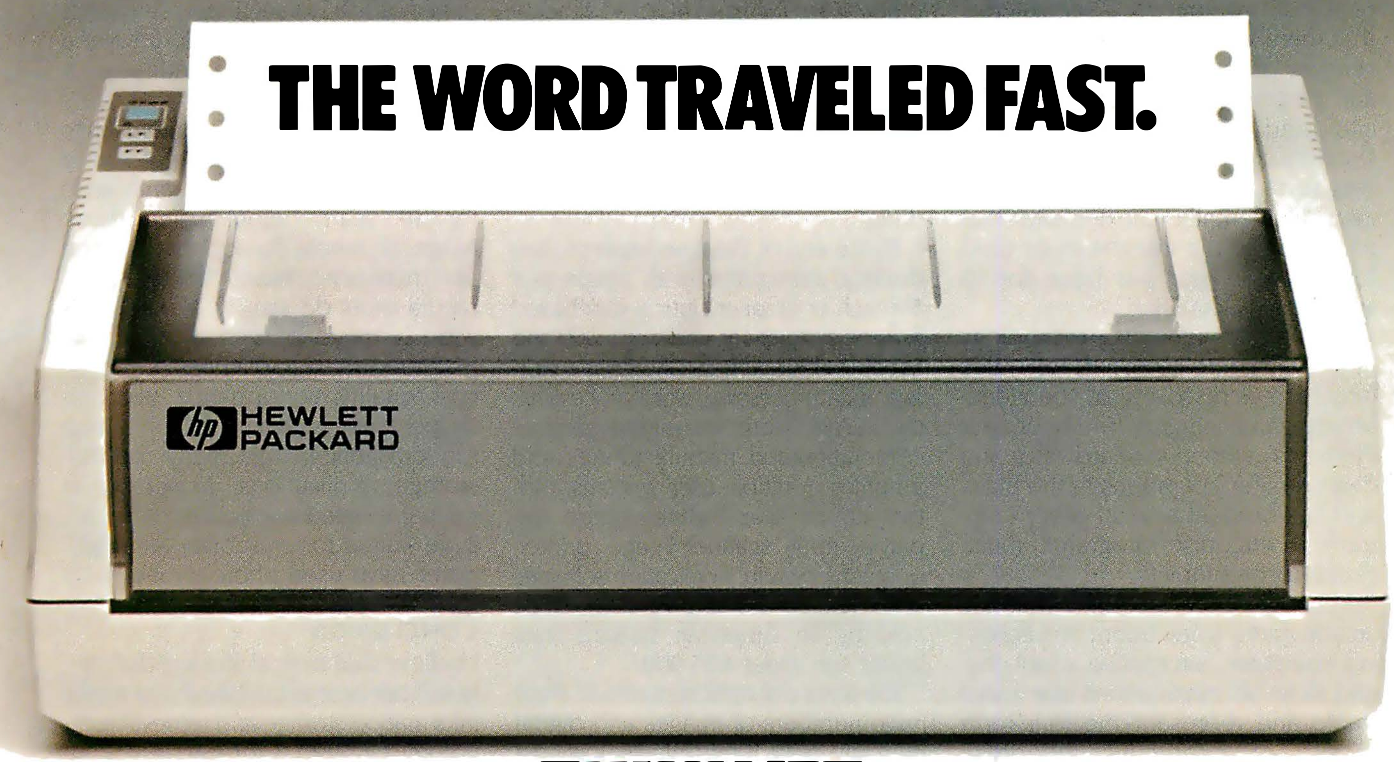
At the seventh Applied Magnetics Conference in Tokyo in early November 1983, 35 magneto-optic papers were presented, indicating how serious Japan is about developing erasable optical media. Included were papers from a large number of firms not previously known to be active in optical-recording research. The emphasis was on advances in carrier-to-noise ratio and environmental stability.

NONDISK FORMATS

We have discussed mostly optical-disk and compact-disk developments, but the past year was also a year in which nondisk formats attracted increasing attention. Drexler Technology Corporation ended the year with 13 licensees signed to distribute its laser cards, which are the size of credit cards and have optical media on them. Most of the licensees will manufacture their own read/write or read-only hardware. The read-only cards will soon be used in small computers for operating systems, application software, and distributed databases (such as catalogs, price lists, etc.). Read/write laser cards will be used for many of the same applications as


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Optical media may soon allow a personal computer to replace a costly graphics system.

floppy disks but are so compact that the cards lend themselves to use in hand-held computers. It seems clear that there will soon be several other vendors offering optical-card media, and a number of media vendors are interested in optical tape. One of Drexler's licensees, NCR, may put 100 megabytes of user data on an optical card. Incidentally, Drexler says that almost all of the interest in its disks for the past year has been for its 4.72-inch (12-cm) size.

Interactive videodisc technology finally came into its own in 1983, due largely to its discovery by the video-arcade-game industry. The boom put Pioneer's videodisc hardware and disk-pressing operations in the black and has brought several other companies' videodisc programs much closer to profitability.

Although there are signs that the arcade-game sales boom is weakening, computer, automobile, telephone, and defense applications are more stable and represent the long-term growth of interactive videodisc technology. There was strong growth in the past year in point-of-sales, industrial training, simulations, military use, and educational applications. Orders for hundreds or thousands of systems are coming in with increasing frequency. The capabilities and speed of computer-controlled videodisc systems are increasing, and with the dramatic decreases in price due by year's end with the introduction of fully integrated systems, there is no longer doubt that the continued growth of the optical videodisc is assured.

Coming This Year

Two significant optical-memory announcements have already been made in 1984: Optical Disc Corporation and Matsushita each announced real-time direct-read-after-write (DRAW) videodisc recorders for delivery in midyear. Optical Disc Corporation will sell its 12-inch polymer/dye media for as little as $50.

The rest of 1984 should see numerous 8-inch and 12-inch optical disk and drive announcements. I expect several read/write and read-only disk announcements shortly from IBM and others, offering from 40 to 550 megabytes of user data on disks that range from 2 inches to 5¼ inches. What will users do with that much storage in a small computer? They will store huge databases, graphics, CAD/CAM, documents, and images on those disks.

By the end of 1984, we expect to see desktop computers with single-user 5¼-inch or smaller optical-disk-based storage systems for under $15,000 and capable of document and image storage, data processing, word processing, CAD/CAM (computer-aided design/computer-aided manufacturing), and graphics. Multiple-user systems with two drives, four high-resolution displays, input scanner, page printer, operating system, application software, and a jukebox holding 50 disks will be sold by an American systems integrator for under $65,000.

The ability of optical media to store huge numbers of images and digital data will make it feasible for low-cost personal computers to replace expensive computer graphics systems and will result in the same explosive growth as the magnetic drive and media business experienced in the last few years.

The actual growth rate of 5¼-inch floppy-disk drives last year was 270 percent, but magnetic-industry forecasters had predicted only a 54 percent rise. This proves the public's appetite for ever greater data storage capacity and leads some observers to call us "informivores."

That is one reason why 64 firms are now researching or developing optical drives and media, including companies from Atari to Xerox. Obviously, there will be a shakeout of many of these organizations, but many new firms and startups entered the business last year, and more will do so this year.

Objections Answered

Objections to optical recording have been raised by magnetic partisans. Some of these are simply not fair. Why wait for adoption of interchange standards before using optical disks? That will probably occur within three years; officially sanctioned standards groups have been at work for over a year in the U.S., Europe, and Japan. It took the magnetic industry 17 years to arrive at magnetic tape interchange standards, and people did not wait to see if magnetic media were archivable for 10 years before using them. Magnetic media do not last that long and there is no reason that all optical media must do so. There will be as wide a range of optical media as magnetic, with varying archivability, cost, quality, performance, size, and shape. There is also no reason to wait for erasability; for many optical-storage applications, erasability is neither needed nor desired. After all, if we waited for erasability, we might never have used photography.

Conclusion

I believe that optical storage definitely will become established as a major information storage and retrieval technology by 1990. I forecast a U.S. installed base of over 8.5 million optical drives in 1990, of which 5¼-inch and smaller optical drives should total over 90 percent, or 7.7 million units. Similarly, 5¼-inch and smaller optical disks will account for over 90 percent of the 553 million disks to be sold in the U.S. in 1990.

There definitely remain problems to be solved concerning optical media and drive stability, producibility, and erasability. Nevertheless, the benefits of optical-storage technology—such as removability, huge capacity, low cost per bit stored, no backup hardware or media needed, no media wear, and the ability to mix digital data, still images, motion video, and audio on the same medium with viable cost/benefits—will ensure that the effort to solve the problems will be worthwhile. ■

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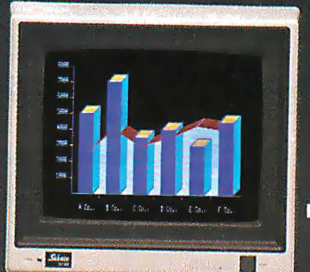
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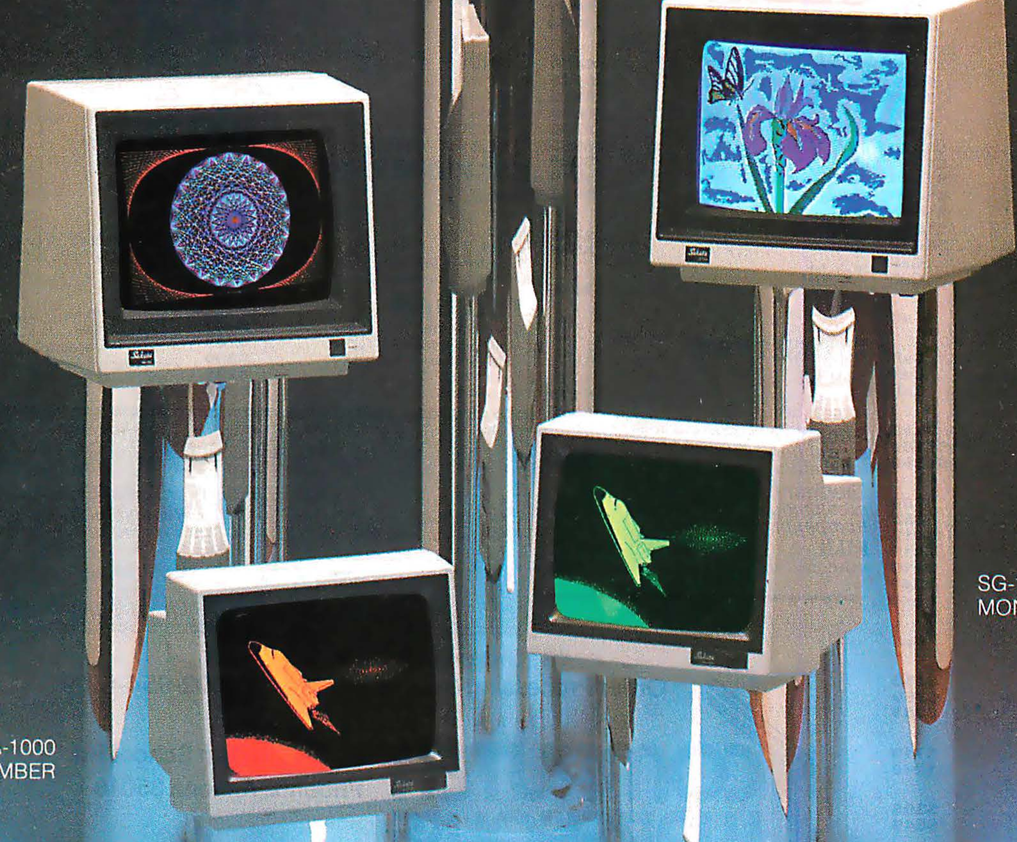
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- 7715 ... $1649
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- P3 ... Call

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- All Printer Models ... Call

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- 1091 ... Call
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- EXP550 Parallel ... $419
- EXP550 Serial ... $419
- 770P ... $849
- 770S ... $849

Star Micronics
- All Printer Models ... Call

Tally
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- MT 180L ... $769
- Spirit 80 ... $255

Toshiba
- P1340 Parallel or Serial ... $719
- P1351 Parallel or Serial ... $1249

Transtar
- 120 Parallel or Serial ... $395
- 130 Parallel or Serial ... $549

MODEMS

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- Smartmodem 300 Baud ... $199
- Smartmodem 1200 Baud ... $480
- Smartmodem 1200B Baud (IBM) ... $409
- Micromodem IIE (Apple) ... $225

US Robotics
- 212A Autodial ... $419
- Password 1200 ... $309

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- A-3 ... $469
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- Viewpoint 90 ... $849

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- QVT 108 Amber ... $639

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Elephant
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- MD1D (Qty 100) ... $159

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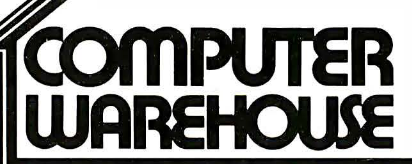
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A DATABASE CATALOG

BY GEORGE BOND

47 database programs at a glance

THE DATABASE-MANAGEMENT systems described on the following pages include a few old favorites and represent a selection of the new generation of programs designed to take advantage of the new generation of microcomputers with their larger memories and faster processors.

With new database-management systems (DBMSs) coming on the market at an incredible pace, we made no attempt to compile a fully inclusive list of programs. Indeed, this would be impossible for anything but an on-line electronic publication—and even an on-line system would keep its operator busy making additions and updates.

The programs are grouped into three broad classes:

- file managers
- relational database managers
- multiuser DBMSs

File managers are roughly the equivalent of a robotic arm and eye that leaf through a card file. They might include sophisticated features but are limited to working with a single file at a time. Relational has taken on many meanings when used to describe a microcomputer-based database program. In general, it means that the user can manipulate more than one file at once when creating reports. It also means that new files can be created—"joined"—from sections of two or more existing files.

Some of the programs listed in this survey have versions that run on local-area networks (LANs). Ideally, a multiuser program would lock a record when it is in use so that only one user at a time could change it. This is not always the case. Databases coupled to LANs constitute a rapidly growing trend. Since we compiled the list, a number of other companies have released programs for use in LANs or have announced their intention to do so.

Some other trends are clear. Just a few years ago, the only powerful DBMS programs generally available for micros were dBASE II, Condor, MDBS, and a handful of others. Today, the choice is so wide as to be bewildering. Off the shelf you can buy relational systems or hierarchical systems; systems using B-trees or inverted B-trees or keyed sequential indices; menu-driven systems and command-driven systems; query-by-example systems and systems with query languages modeled on the mainframe world's SQL (system query language). Even the low end of the market is getting reasonably powerful DBMS programs—there is even a "freeware" DBMS with muscle for the IBM PC.

Prices have not risen proportionally with power. Many very flexible and powerful DBMS programs sell for well under $500 (in real, what-you-actually-pay prices, $595 and $695 still seem to have some sort of magic as list prices) and few DBMS programs for micros break the kilobuck barrier.

The information in the table was provided by the programs' vendors. Most of the research was done by Faith Kluntz and Beverly Jackson, two of the unheralded stalwarts of the BYTE staff.

George Bond is managing editor of User News *for* BYTE. *He can be contacted at* POB 372, *Hancock,* NH 03449.

(continued)

FILE MANAGER PROGRAMS

PRODUCT NAME	Aura	BPI Information Management	CataList	Concentric Information Processor (CIP)	Database Manager II/ The Integrator
VENDOR	Softrend, 2 Manor Parkway, Salem, NH 03079, (603) 898-1896	BPI Systems Inc., 3423 Guadalupe, Austin, TX 78705, (512) 454-2801	Stone and Associates Software Publishing Inc., 7910 Ivanhoe Ave., Suite 319, La Jolla, CA 92037, (800) 624-2262; in CA (619) 459-9173	Concentric Data Systems Inc., 18 Lyman St., Westboro, MA 01581, (617) 366-1122	Alpha Software Corp., 30 B St., Burlington, MA 01803, (617) 229-2924
MINIMUM HARDWARE	IBM PC, XT, or compatible; 256K bytes RAM. Two double-sided floppy-disk drives or one floppy-disk drive and one hard-disk drive.	IBM PC, XT, or Compaq; 128K bytes RAM, two 320K-byte floppy-disk drives.	IBM PC, XT, or compatible; 128K bytes RAM, two double-sided floppy-disk drives.	IBM PC, XT, or compatible; 128K bytes RAM (DOS 1.1), 192K bytes RAM (DOS 2.0); two double-sided, double-density floppy-disk drives or one floppy-disk drive and one hard-disk drive.	IBM PC, XT, or compatible; 128K bytes RAM (DOS 1.1), 192K bytes RAM (DOS 2.0), two floppy-disk drives, at least one double-sided.
PRICE	$595	$425	$195	$395	$295
OPERATING SYSTEMS	MS-DOS 2.0, PC-DOS 2.0	PC-DOS or MS-DOS	PC-DOS, MS-DOS	PC-DOS or MS-DOS	PC-DOS, MS-DOS
MAXIMUM CHARACTERS PER FIELD	255	76	186	50	60
MAXIMUM FIELDS PER RECORD	unlimited	100	20	40	40
MAXIMUM RECORDS PER FILE	unlimited	unlimited	unlimited	65,000	32,767
MAXIMUM NUMBER OF FILES OPEN AT ONE TIME	1	1	1	1	1
FIXED OR VARIABLE RECORD LENGTHS	variable	fixed	fixed	both	fixed
MAXIMUM NUMBER OF KEY FIELDS	8	50	3	40	5
TYPE OF INDEX ORGANIZATION	inverted B-tree	N/A	N/A	B+tree	ISAM
COPY PROTECTED	yes	no	no	yes	no
OTHER FILE FORMATS SUPPORTED	Soon will import ASCII, DIF, 1-2-3, WordStar.	Future add-on	ASCII; output only WordStar, MultiMate	DIF, ASCII, delimited ASCII	ASCII, WordStar, 1-2-3, SYLK, MailMerge
COMMENTS	Can reformat data any time; automatically reconstructs data; constructs its own menus; comes with spreadsheet, word processing, and graphics; has password protection levels; menu-driven applications development.	Two levels of password protection, supports word-processor-like global search of files.	Supports 30 different printers, PC version holds 2000 records per disk and can span disks, XT versions sells for $250 and allows 32,000 records on the hard disk.	What-you-see-is-what-you-get report generation, horizontal scrolling to 132 columns.	—

DATAHANDLER-PLUS	DB Master Version 4PLUS	FASTFILE	FilePlan	Micro IPF	Next Step
Miller Microcomputer Services, 61 Lake Shore Rd., Natick, MA 01760, (617) 653-6136	Stoneware Inc., 50 Belvedere St., San Rafael, CA 94901, (415) 454-6500	Datamate Co., 4135 South 100th East Ave., #128, Tulsa, OK 74146, (918) 664-7276	Chang Laboratories Inc., 5300 Stevens Creek Blvd., San Jose, CA 95129, (800) 973-8800; in CA (800) 831-8080	Control Data Corp., 8100 34th Ave. S, Bloomington, MN 55440, (612) 690-3530	Execuware Inc., 4018 Country Club Rd., Winston-Salem, NC 27104, (919) 760-3576
IBM PC or compatible; one 160K-byte floppy-disk drive, MMSFORTH 2.2.	Apple II+ with 16K-byte RAM card or Apple IIe, one to four floppy-disk drives.	IBM PC, XT, or compatible; 128K bytes RAM, two floppy-disk drives or one floppy-disk drive and one hard-disk drive.	IBM PC or compatible; 64K bytes RAM, two 190K-byte floppy-disk drives.	IBM PC or Zenith Z-100; 128K bytes RAM, two floppy-disk drives or one floppy-disk drive and one hard-disk drive.	IBM PC or Compaq; two disk drives, 128K bytes RAM.
$100	$350	$195	$295	$465	$345
MMSFORTH/IBM PC	DOS 3.3	PC-DOS, MS-DOS	PC-DOS, MS-DOS, CP/M	PC-DOS, ZDOS, MS-DOS	PC-DOS, MS-DOS
255	100	40	75	60	78
255	100	50	32	200	99
unlimited	unlimited	unlimited	2048	unlimited	32,767
1	1	1	1	1	1
variable	fixed	fixed	both	fixed	fixed
unlimited	10	1	0	3	15
N/A	ISAM	keyed	B-tree	B-tree	B-tree
no	yes	no	no	no	yes
ASCII (export only)	DIF	none without programming	MailMerge	uses DIF, ASCII	ASCII
Predefined or user-defined templates, active windows, supports FORTHWRITE word-processing program, requires $249.95 MMSFORTH system disk.	Supports disk spanning of up to 200 floppy disks, does not support an 80-column card, a Macintosh version has been announced at $195.	Written in MVP COBOL, includes inquiry-based report writer.	Allows worksheet format similar to spreadsheets.	Graphics subsystem supports monitor, printer, or plotter; supports text merge into documents; can call other DOS programs using defined menu functions; supports communication with CDC Cyber; includes sophisticated report writer.	Generates BASIC programs with built-in menus and Help screens.

PRODUCT NAME	Nutshell Information Manager	OMNIFILE	Organizer I	PC-File III	ResQ
VENDOR	Leading Edge Products Inc., 225 Turnpike St., Canton, MA 02021, (800) 343-6833	SSR Corp., 1600 Lyell Ave., Rochester, NY 14606, (716) 254-3200	Random House School Division, 400 Hahn Rd., Westminster, MD 21157, (800) 331-5469	Jim Button, POB 5786, Bellevue, WA 98006, (206) 746-4296	Key Software Inc., 1000 Skokie Blvd., Suite 200, Wilmette, IL 60091, (312) 256-6776
MINIMUM HARDWARE	IBM PC, XT, and compatibles; 256K bytes RAM; one double-sided, double-density floppy-disk drive or one floppy-disk drive and one hard-disk drive.	IBM PC, XT, or compatible; 128K bytes RAM, two floppy-disk drives, at least one of which is 320K bytes. With PC-DOS 2.0, 192 bytes RAM.	(IBM PC) 96K bytes RAM; (TRS-80 III or 4) 48K bytes RAM; two floppy-disk drives.	128K bytes RAM, one 320K-byte floppy-disk drive or two 160K-byte floppy-disk drives or one floppy-disk drive and one hard-disk drive.	IBM PC, XT, or compatible; 128K bytes RAM, two floppy-disk drives or one floppy-disk drive and one hard-disk drive.
PRICE	$395	$425	$81	$49	$295
OPERATING SYSTEMS	PC-DOS, MS-DOS	PC-DOS, MS-DOS	PC-DOS, TRSDOS	PC-DOS 1.1 or later, MS-DOS 2.0 or later	PC-DOS, MS-DOS
MAXIMUM CHARACTERS PER FIELD	unlimited	1828	40(IBM), 32(TRS-80)	65	80
MAXIMUM FIELDS PER RECORD	unlimited	64	15(IBM), 11(TRS-80)	42	60
MAXIMUM RECORDS PER FILE	unlimited	unlimited	variable	10,000	32,767
MAXIMUM NUMBER OF FILES OPEN AT ONE TIME	1	1	1	1	1
FIXED OR VARIABLE RECORD LENGTHS	variable	variable	variable	fixed	fixed
MAXIMUM NUMBER OF KEY FIELDS	unlimited	2	0	42	38
TYPE OF INDEX ORGANIZATION	keyed	modified B-tree	sequential	pointer	N/A
COPY PROTECTED	no	yes	yes	no	no
OTHER FILE FORMATS SUPPORTED	ASCII	DIF, ASCII	none	DIF, ASCII, MailMerge, PC-Calc	ASCII, 1-2-3,
COMMENTS	Every word in every field is indexed. A multifile version is planned.	Can support multiple logical files.	—	User-supported software. Menu-driven program, full-screen data entry, macro keys, calculated field entries.	Nine security levels per field, password protection on files, fast sorts, calculated fields.

RELATIONAL DATABASE PROGRAMS

Superbase 64	TMP/MANAGER I	UltraFile	10-Base	Citation	CodeWriter
Precision Software Inc., 820 Second Ave., Suite 1100, New York, NY 10017, (212) 490-1825	The United Software Co., 2431 East Douglas, Wichita, KS 67211, (316) 684-5281	Arrays Inc./Continental Software, 11223 South Hindry Ave., Los Angeles, CA 90045, (213) 410-3977	Fox Research, 7005 Corporate Way, Dayton, OH 45459, (513) 433-2238	Eagle Enterprises, 2375 Bush St., San Francisco, CA 94115, (415) 346-1249	CodeWriter Corp., 7847 North Caldwell Ave., Niles, IL 60648, (800) 621-4109
Commodore 64; one floppy-disk drive or one floppy-disk drive and one hard-disk drive.	IBM PC or compatible; one floppy-disk drive, 128K bytes RAM.	IBM PC, XT; 128K bytes RAM, two double-sided floppy-disk drives or one floppy-disk drive and one hard-disk drive.	IBM PC, XT, or compatible; 192K bytes RAM; MS-DOS 2.0, two disk drives, cursor-addressable monitor.	IBM PC or compatible: 96K bytes RAM. CP/M systems: 58K bytes RAM. Two floppy-disk drives or one floppy-disk drive and one hard-disk drive.	Apple II+, IIe, Commodore 64, PCjr: one floppy-disk drive. IBM PC: two floppy-disk drives.
$99	$365	$195	$495	$185	$249; Commodore version $99
proprietary	PC-DOS, MS-DOS	PC-DOS 1.1 or 2.0	MS-DOS 2.0	CP/M-80, PC-DOS	standard operating system for each machine listed
1108	50	100	9999	800	39 (40 column), 79 (80 column)
127	150	50	unlimited	24	49 (40 column), 100 (80 column)
unlimited	unlimited	32,767	unlimited	unlimited	operating system limited
1	1	1	16	1	3 (40 column), 4 (80 column)
fixed	both	fixed	fixed	both	both
1	0	5	unlimited	unlimited	2
B+tree	sequential	pointer	B-tree	B-tree	sequential, random
yes	yes	no	no	no	yes
none	TMP/Free Form	ASCII, DIF, FCM, WordStar	DIF, ASCII	ASCII	none
—	Menu-driven, but commands available.	Up to five user-defined report forms per database, graphing module supports screen or printer (plotter support announced), menu-driven hardware configuration, supports disk spanning.	Can be used in a network.	Three predefined templates for journal and book reference files and address files; user may define others; up to six key words/record (unlimited total key words) and up to 800 characters of free-form text/record.	Tutorials on disk; written in BASIC.

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QUME *Sprint 11/40 Plus, Sprint 11/55 Plus*.

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PRODUCT NAME	Condor 3	DataEase	DATAVU PLUS	DB3	dBASE II 2.4
VENDOR	Condor Computer Corp., 2051 South State St., Ann Arbor, MI 48104, (800) 221-8479	Software Solutions Inc., 305 Bic Dr., Milford, CT 06460, (203) 877-9268	Thinkers' Soft Inc., POB 221, Garden City, NY 11530, (516) 294-8104	Tarbell Electronics, 950 Dovlen Place, Suite B, Carson, CA 90746, (213) 538-4251	Ashton-Tate, 10150 West Jefferson Blvd., Culver City, CA 90230, (213) 204-5570
MINIMUM HARDWARE	8088 computers with 80K bytes RAM, one double-sided floppy-disk drive; DECmate; also 8-bit CP/M computers with 64K bytes RAM (including APPLE II with CP/M card).	IBM PC, XT, or compatible; DEC Rainbow; TI Professional; Wang Professional; Victor 9000.	CP/M-80 systems: 64K bytes RAM; PC-DOS, MS-DOS, and CP/M-86 systems: 128K bytes RAM.	Intel 808X CPU system: 56K bytes RAM; one floppy-disk drive.	IBM PC, XT, or compatible; 128K bytes RAM, one floppy-disk drive. CP/M-86 machines with 128K bytes RAM. CP/M-80 2.0 or later with 48K bytes RAM. Cursor-addressable monitor.
PRICE	$650	$600	$250	$249	$495
OPERATING SYSTEMS	PC-DOS, MS-DOS, CP/M-80, CP/M-86, MP/M-80	PC-DOS, MS-DOS	PC-DOS, MS-DOS, CP/M-86, CP/M-80	CP/M 2.2, 3.0, -86, CCP/M-86	see above
MAXIMUM CHARACTERS PER FIELD	127	255	127	1000	254
MAXIMUM FIELDS PER RECORD	127	255	127	100	32
MAXIMUM RECORDS PER FILE	65,535	65,535	unlimited	unlimited	65,535
MAXIMUM NUMBER OF FILES OPEN AT ONE TIME	1	32	8	19	2
FIXED OR VARIABLE RECORD LENGTHS	fixed	fixed	both	both	fixed
MAXIMUM NUMBER OF KEY FIELDS	8	unlimited	4	100	7
TYPE OF INDEX ORGANIZATION	B-tree	B-tree	N/A	B-tree	B+tree
COPY PROTECTED	no	no	no	no	no
OTHER FILE FORMATS SUPPORTED	ASCII	ASCII, DIF, SYLK	ASCII	ASCII	ASCII
COMMENTS	Large user base, established program, multiuser version planned for XENIX and UNIX, very limited relational capabilities.	All options (filename, fields, etc.) always showing on screen; three levels of password protection; multiuser version has been announced.	Automatic screen design, report generator.	CCP/M-86 version supports multiusers, program generator built in.	Includes programming language; utilities available; multiuser system for TurboDOS, 3COM, Ethernet $995; dBASE III requires 256K bytes RAM; PC-DOS 2.0 allows 4096 characters/field, 128 fields/record, unlimited records/file, 10 files open at once, copy protected.

FMS-80	Fast File	filePro	filePro 16	Knowledgeman	!.AN: DATASTORE
FMS Software Ltd., 54 North Main St., Spring Valley, NY 10977, (914) 425-3333	ICCS, 777 Leesburg Pike, Falls Church, VA 22043, (703) 893-4404	The Small Computer Co. Inc., 230 West 41st St., Suite 1200, New York, NY 10036, (800) 847-4740	The Small Computer Co. Inc., 230 West 41st St., Suite 1200, New York, NY 10036, (800) 847-4740	Micro Data Base Systems Inc., POB 248, Lafayette, IN 47902, (317) 463-2581	Software Connections Inc., 2401 Mission College Blvd., Santa Clara, CA 95054, (800) LAN-DBMS; in CA (800) LAN-DATA
48K bytes RAM (64K bytes recommended), two 240K-byte floppy-disk drives or one floppy-disk drive and one hard-disk drive.	IBM PC: 128K bytes RAM.	Apple II with CP/M SoftCard, 64K bytes RAM; two floppy-disk drives; most CP/M systems.	IBM PC: 256K bytes RAM; one hard-disk drive.	192K bytes RAM.	IBM PC, XT, or compatibles or TI Professional: 192K bytes RAM, one floppy-disk drive and one hard-disk drive or two floppy-disk drives.
$395	$350	$199	$495	$500	$450
CP/M, CP/M-86, PC- or MS-DOS, MmmOST, TurboDOS, MP/M	PC-DOS	CP/M	PC-DOS	CP/M-86, PC-DOS, MS-DOS	MS-DOS, PC-DOS, p-System
255	256	1020	999	65,535	4096
255	96	99	999	255	512
65,535	65,535	65,535	16,000	65,535	unlimited
19	5	1	10	unlimited	15
both	fixed	variable	variable	fixed	fixed
unlimited	25	1	12	unlimited	16
ISAM	ISAM	N/A	B-tree	B+tree	B+tree
no	yes	no	no	no	no
ASCII	none	ASCII	ASCII, DIF, SYLK, WordStar	ASCII	DIF, ASCII, WordStar
Runs under UNIX-like shell, 16-bit version costs $495, multiuser version that supports record locking only on change costs $595.	Applications generator producing Microsoft BASIC source code, should be used with Microsoft BASIC compiler for adequate speed, provides interactive inquiry screens.	—	Processing language available for sophisticated applications development; programming not necessary for most applications; dBASE II, pfs:File interchange utilities available at $50 each; upwardly compatible with multiuser system.	Integrated spreadsheet, statistics, printed-forms management, SQL-like inquiry, screen I/O management, structured program language. Options: graphics ($225), screen print ($100), mouse support ($100), run time support ($100).	Help screen indexed to manual, levels of password protection.

PRODUCT NAME	power-base 2.0	R:base 4000	RL-1 Data Base	Revelation	SALVO
VENDOR	PowerBase Systems Inc., 12 West 37th St., New York, NY 10018, (212) 947-3590	MicroRIM Inc., 3380 146th Place SE, Bellevue, WA 98007, (206) 641-6619	ABW Corp., POB M1047, Ann Arbor, MI 48106, (313) 663-3011	Cosmos, 19530 Pacific Highway S, Suite 102, Seattle, WA 98188, (206) 824-9942	Software Automation Inc., 14333 Proton Rd., Dallas, TX 75234, (214) 392-2802
MINIMUM HARDWARE	IBM PC, XT, or compatible; 256K bytes RAM, two double-sided floppy-disk drives or one floppy-disk drive and one hard-disk drive.	IBM PC or compatible, DEC Rainbow, TI Professional, HP 150, most CP/M systems; 256K bytes RAM, two double-sided floppy-disk drives.	IBM PC, XT, or compatible; 128K bytes RAM, one floppy-disk drive (two recommended) or one floppy-disk drive and one hard-disk drive.	IBM PC, XT, or compatible; 320K bytes RAM, two 320K-byte floppy-disk drives, 8087 NDP chip recommended.	64K bytes RAM (CP/M), 128K bytes RAM (MS-DOS), two 256K-byte floppy-disk drives.
PRICE	$395	$495	$495	$950	$496
OPERATING SYSTEMS	PC-DOS, MS-DOS	PC-DOS, MS-DOS, CP/M-80	PC-DOS, MS-DOS	PC-DOS, MS-DOS, Pick	MS-DOS, CP/M, PC-DOS
MAXIMUM CHARACTERS PER FIELD	80	1530	1024	65,535	78
MAXIMUM FIELDS PER RECORD	64	400	unlimited	65,535	16
MAXIMUM RECORDS PER FILE	65,534	unlimited	65,531	unlimited	32,767
MAXIMUM NUMBER OF FILES OPEN AT ONE TIME	10	40	unlimited	unlimited	16
FIXED OR VARIABLE RECORD LENGTHS	both	fixed	fixed	variable	fixed
MAXIMUM NUMBER OF KEY FIELDS	6	400	unlimited	unlimited	variable
TYPE OF INDEX ORGANIZATION	B-tree	inverted B-tree	modified B-tree	inverted list	B-tree
COPY PROTECTED	no	yes	no	no	no
OTHER FILE FORMATS SUPPORTED	1-2-3, DIF, pfs, dBASE II, MultiMate	ASCII, SYLK, 1-2-3, DIF	ASCII	ASCII	DIF, ASCII (export only)
COMMENTS	Data-zoom allows linking of related records for special uses, mailing-label generator.	CLOUT natural-language query program available ($195), procedural language included. R:base 6000 is a multiuser version of this program.	SQL-like query language, menu-driven data definition and relational editor, programming interface to any language.	Application generator included; RBASIC is a true 16-bit structured BASIC worth a look in its own right; network version with semaphore locking announced ($1400 for 1–4 users).	Expert system query, automatic navigation through multiple files.

MULTIUSER SYSTEM PROGRAMS

SAVVY PC	Sensible Solution	Smart Data Manager	filePro 16	Informa
Excalibur Technologies Corp., 800 Rio Grande NW, Suite 21, Albuquerque, NM 87104, (800) 551-5199	O'Hanlon Computer Systems Inc., 11058 Main St., Suite 225, Bellevue, WA 98004, (206) 454-2261	Innovative Software, 9300 West 110 St., Overland, KS 66210, (913) 383-1089	The Small Computer Co. Inc., 230 West 41st St., Suite 1200, New York, NY 10036, (800) 847-4740	Unlimited Processing Inc., 8382 Baymeadows Rd., Suite 8, Jacksonville, FL 32216, (800) 874-8555
IBM PC, XT, or compatible; 64K bytes RAM, one double-sided or two single-sided floppy-disk drives.	128K bytes RAM, two 320K-byte floppy-disk drives or one floppy-disk drive and one hard-disk drive, 80 by 24 screen with addressable cursor.	IBM PC, XT, or compatible; 192K bytes RAM, two double-sided floppy-disk drives or one floppy-disk drive and one hard-disk drive.	TRS-80 Model 16 (XENIX) or many UNIX systems; 256K bytes RAM, one hard-disk drive.	64K bytes RAM (CP/M-80, DPCOS, MmmOST, TurboDOS); 256K bytes RAM (DPCOS-86, CP/M-86, MP/M-86, MS-DOS 2.X); two 320K-byte drives.
$395	$695	$495	$495	$795
SAVVY	CP/M, MS-DOS, TurboDOS, MP/M, CPC/OS, MmmOST	PC-DOS, MS-DOS	XENIX, UNIX	see above, and 3COM, PCNet, Davong, Novell, Corvus
255	255	1000	999	*
254	384	255	999	*
20,000	1000	100,000	16,000	65,535
10,000	10	10	10	unlimited
variable	fixed	variable	variable	fixed
254	10 per file	15	12	50
N/A	B+tree	pointer	B-tree	B-tree
no	no	yes	no	no
ASCII	N/A	ASCII, DIF, 1-2-3, WordStar	ASCII, DIF, SYLK, WordStar	DIF, import ASCII, and delimited ASCII
Includes procedural language, has a unique pattern-recognition facility that lets you query on inexact descriptions, report-writing and file-creation features are menu-driven.	Multiuser version available that supports record and file locking ($995).	Supports 8087 NDP, mouse; has math, statistical, business, and decision functions.	dBASE, pfs interchange utilities available; XENIX system marketed by Radio Shack as ProFile 16; UNIX system sells for $995; programming language for sophisticated applications; no programming necessary for most applications.	*1022 characters per record single-user system; 8190 multiuser; multiprocessor version $995; network version requires hard-disk drive, costs $1495; all support multiusers, but multiuser version locks records only at write; menu-driven; has password protection levels.

PRODUCT NAME	LAN:DATASTORE	Optimum Version 7.03	PDBase	Unify
VENDOR	Software Connections Inc., 2401 Mission College Blvd., Santa Clara, CA 95054, (800) LAN-DBMS; in CA (800) LAN-DATA	Uveon Computer Systems Inc., 300 South Jackson St., Suite 250, Denver, CO 80209, (303) 831-7000	IOTC Inc., 211 South 3rd, Laramie, WY 82070, (307) 721-5818	Unify Corp., 4000 Kruse Way Place, Bldg. 2, Lake Oswego, OR 97034, (503) 635-6265
MINIMUM HARDWARE	IBM PC, XT, or compatibles or TI Professional; 192K bytes RAM, one floppy-disk drive and one hard-disk drive or two floppy-disk drives.	Two 320K-byte floppy-disk drives, 64K bytes RAM (CP/M) or 128K bytes RAM (IBM PC).	64K bytes RAM, two floppy-disk drives.	256K bytes RAM, one floppy-disk drive and one hard-disk drive.
PRICE	$945	$595	$245*	$1495
OPERATING SYSTEMS	MS-DOS, PC-DOS, p-System	CP/M-80, -86, PC-DOS, MP/M-86, TurboDOS, MmmOST	p-System, CCOS, PC-DOS, MS-DOS	UNIX, XENIX, and other UNIX implementations.
MAXIMUM CHARACTERS PER FIELD	4096	255	32,767	256
MAXIMUM FIELDS PER RECORD	512	50	1000	256
MAXIMUM RECORDS PER FILE	unlimited	varies	2500	unlimited
MAXIMUM NUMBER OF FILES OPEN AT ONE TIME	15	10	32	unlimited
FIXED OR VARIABLE RECORD LENGTHS	fixed	variable	variable	fixed
MAXIMUM NUMBER OF KEY FIELDS	16	3	1000	unlimited
TYPE OF INDEX ORGANIZATION	B+tree	hashed	hashed	hashed
COPY PROTECTED	no	no	no	no
OTHER FILE FORMATS SUPPORTED	DIF, ASCII, WordStar	MailMerge	ASCII	ASCII
COMMENTS	Can be networked, $945 version supports up to five users; a second version is available to support up to 16 users for $1945.	Shared multiuser version available; procedural language; two levels of password protection; also supports n/Star, Novell, NETWARE.	*Apple version, concurrent systems from $795, nine levels of password security, PDBase language allows access from other languages, network environment lets you mix/match computers, run-time packages available, user-tailorable error messages, single-user pBASE $125.	Four different index organizations: the primary field is hashed, others use B-trees. Cross-files linking is available. Menu-driven operation or applications development providing host language interface to C library subroutines. Prices to $14,500 on VAX 780.



Circle 80 on inquiry card.

You can't buy an IBM® PC with

Here are five important measurements to help you make the best choice:

IBM forces you to choose:

Buy a monochrome card and monitor for high-resolution text. (Essential for word processing and spreadsheets.)

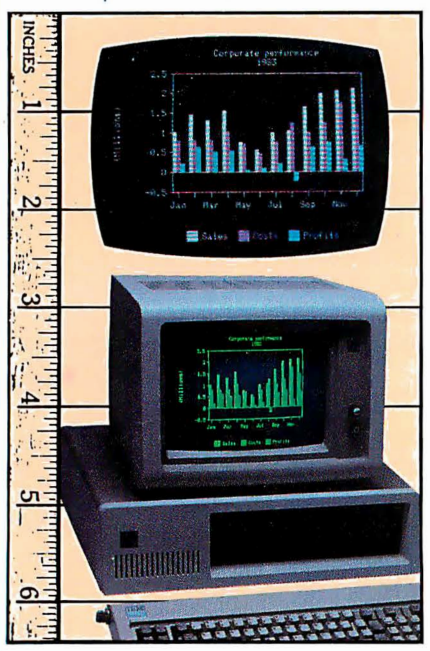
Or buy a color card and color monitor for graphics. (Lotus™ 1-2-3,™ for example, uses lots of graphics, as well as text.)

You can invest in both; you can sacrifice one or the other; you can settle for a non-standard compromise.

Or you can buy Paradise.

Here's how we've measurably eased your job of choosing the best video display (saving you a lot of money in the process).

1. Measure video functions.



The Paradise Modular Graphics Card™ gives you *full screen, 16-shade* graphics on *any* display, including IBM's high-resolution monochrome monitor.

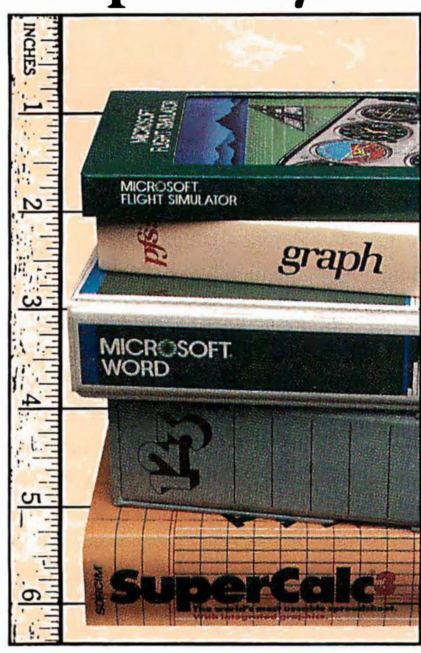
IBM's color/graphics card can display 16 colors on a color monitor.

So can the Paradise Modular Graphics Card.

But that's where the similarity ends. When you use color/graphics software with the Paradise Modular Graphics Card and a monochrome monitor, it translates those colors into a true 16-shade gray scale. With full screen display, flicker-free scrolling and clear, crisp character sets (like those of IBM) in all modes.

Naturally, the best video card fits either the IBM PC *or* XT, and works with any monitor you choose: IBM monochrome (or equivalent), RGB or composite video.

2. Measure software compatibility.



Many video cards only work with specially modified software. The Paradise Modular Graphics Card runs popular off-the-shelf color/graphics software on your choice of monitors. *Unmodified.*

Most cards that offer graphics on a monochrome monitor force you to sacrifice off-the-shelf software compatibility.

Paradise doesn't want you to compromise.

Of course the Paradise Modular Graphics Card runs Lotus 1-2-3 graphics on an IBM monochrome monitor.

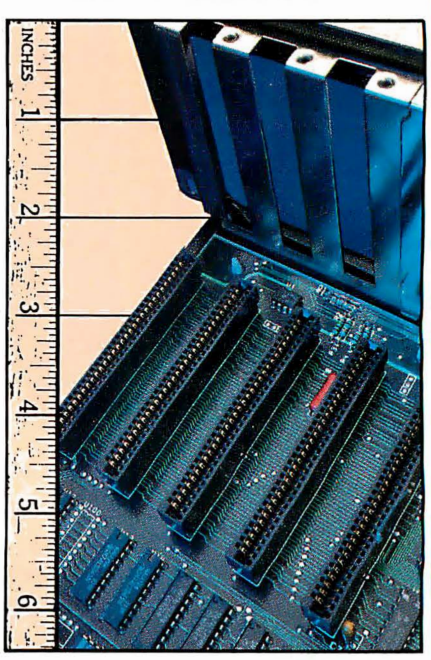
But it also runs almost all unmodified off-the-shelf color/graphics software.

Like PFS®:GRAPH, SuperCalc,®3 Flight Simulator,® and Symphony.™

No wires. No tricks.

A menu-driven software system—with a user interface much like that of Lotus 1-2-3—lets you take advantage of all the Paradise Modular Graphics Card's features.

3. Measure slot utilization.



Unlike other video cards, the Paradise Modular Graphics Card gives you *additional popular functions in a single slot*. This may be the only card you'll ever need.

You need to worry about slots for future expansion. Since you *must* use

out choosing a video card.

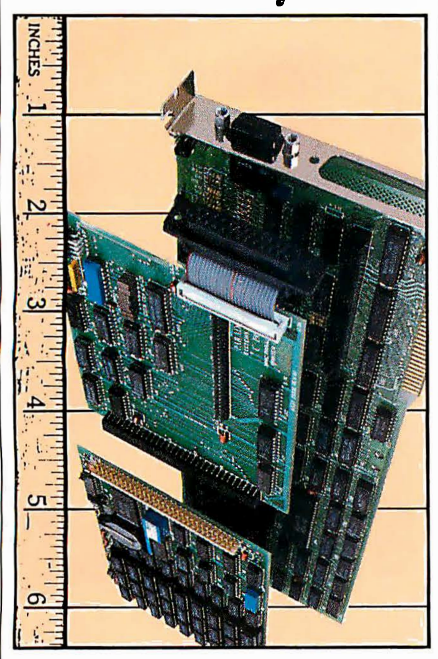
a slot for video support, why not pack it with more functions?

The Paradise Modular Graphics Card puts color and monochrome video support *plus* your choice of the most commonly requested enhancements into one slot.

Enhancements like extra memory, clock calendar, floppy disk controller, parallel, serial or game ports.

Leaving you measurably more room to expand.

4. Measure cost efficiency.

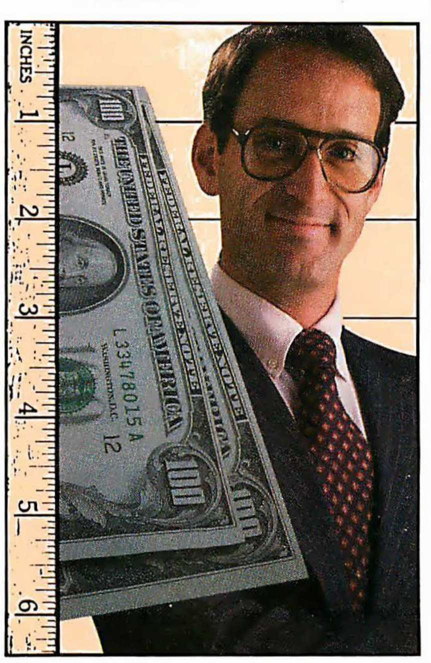


Unlike other multifunction cards, the Paradise Modular Graphics Card lets you choose the options you need, now or later.

You select the features you *want*, when you want them—no more, no less. So you pay only for what you need.

Choose one module from list A, one from list B, or one from each list. The Paradise Modular Graphics Card fits in a single PC *or* XT slot, even with both modules attached. And without imposing on adjacent slots.

5. Measure value.



Value: the ratio of performance to price. No matter how you configure the Paradise Modular Graphics Card, you get more performance for your money, and more performance for your slot.

You'd have to combine several other cards to even approach the Paradise Modular Graphics Card's functionality.

Obviously, that would take up several slots in your PC.

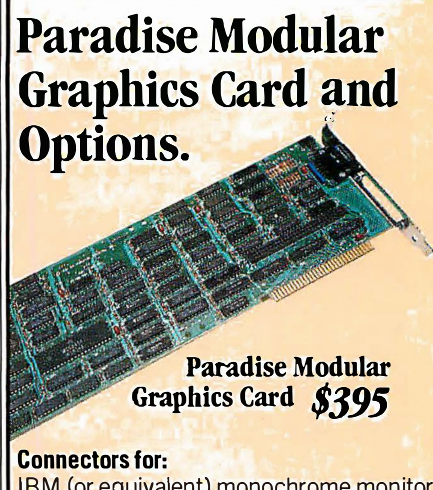
It would also cost you a lot more money.

And if you review measurements one through four in this ad, you'll realize that no other card—or combination of cards—can give you better PC performance.

What about reliability?

Guaranteed by a one year warranty.

Paradise Modular Graphics Card and Options.



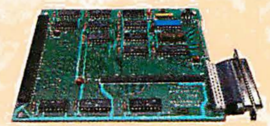
Paradise Modular Graphics Card *$395*

Connectors for:
IBM (or equivalent) monochrome monitor *or* • RGB monitor *or* • Composite video monitor • Light pen • RF modulator • Expansion modules

Addressing:
16K video memory starting at B8000H

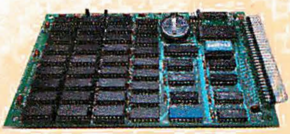
Software included:
RAM disk • Print buffer

A Module Options:



Parallel printer port *or* • Serial RS232 port *or* • Game port

B Module Options:



256K RAM memory/clock calendar *or* • 384K RAM memory *or* • Floppy disk controller/parallel printer port

Go to the IBM dealer nearest you or call us toll-free.

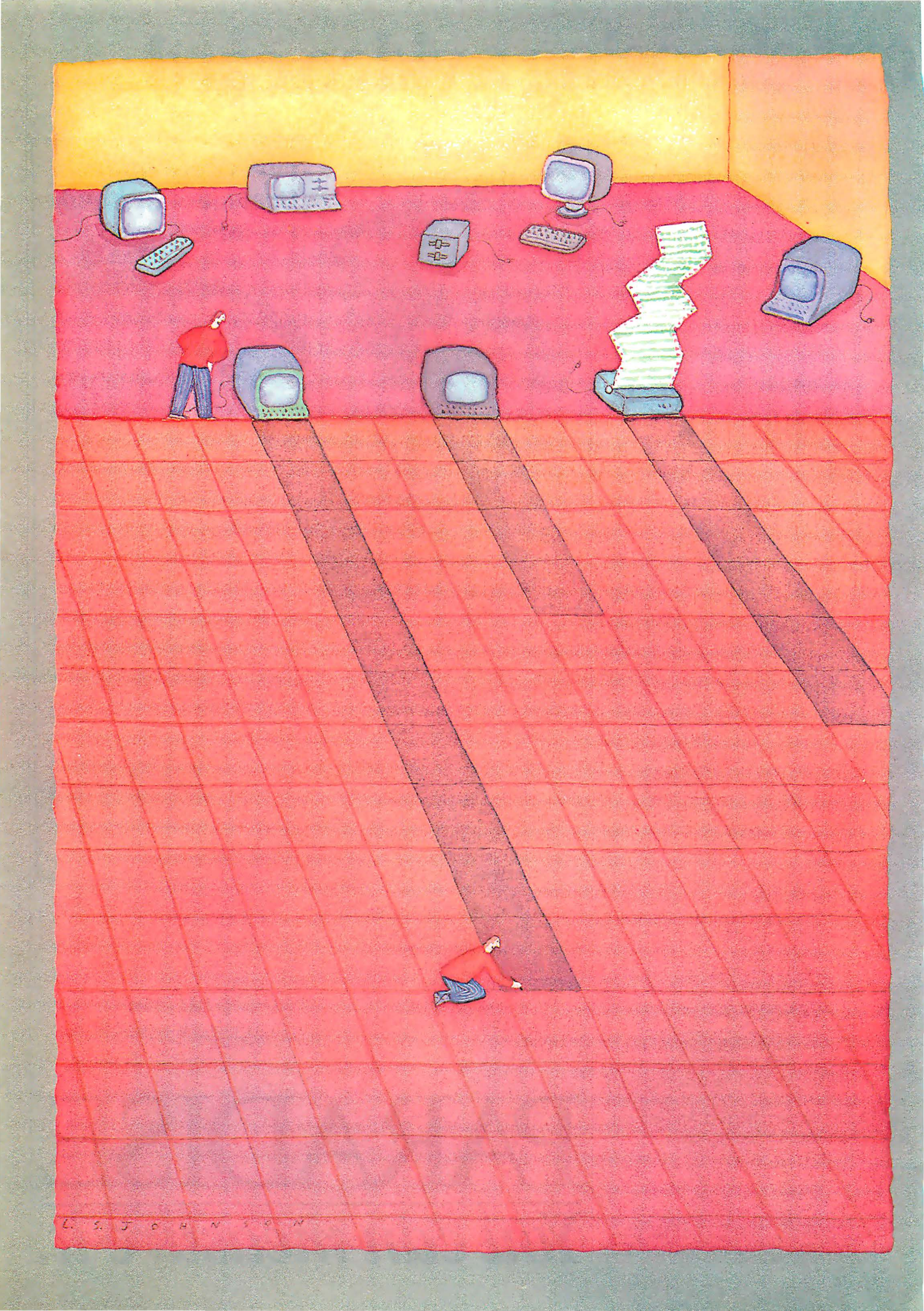
Within CA:
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PARADISE

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L. S. JOHNSON

Reviews

IN JUNE OF 1983 we published a design article on a new machine from Fujitsu, the largest computer manufacturer in Japan. This product, the Fujitsu Micro 16s, features 8086 and Z80 processors with interchangeable microprocessor boards and a variety of operating systems and disk-drive formats. Unfortunately, it took quite a while to get most of the products mentioned in that article. The main system arrived one month, the 8-inch disk drives another, and so on until we got a fairly complete and powerful system. We gave the project to Alex Pournelle, a resident of Chaos Manor, and asked him to put it through its paces. His findings lead off our review section this month.

Another Japanese company that has rather recently entered the U.S. microcomputer market is Panasonic (a division of Matsushita). Panasonic's entry is a sleek transportable that, unlike the Fujitsu, is compatible with the IBM Personal Computer. It also contains its own 8½-inch thermal printer and a sizable bundle of software. I could go on, and in fact I already have. For more details, see my review of this impressive little machine.

Next we offer a look at yet another word processor for the IBM PC. This one is called Volkswriter Deluxe. Stevanne Ruth Lehrman examines this package to see if it is indeed the people's word processor.

Speaking of word processors for the people, two other word processors may make a similar claim. In fact, since both of these programs run on the Apple II and will soon run on the Commodore 64, they may have a better shot at that title. These products, HomeWord and Cut & Paste, are inexpensive and easy to use. Keith Carlson looks at just how useful they are. Of course, neither program is meant to help you write the Great American Novel, but each provides some good features for an inexpensive price.

Lastly, we move on to some products that are related to this month's theme of Databases. First, George Bond, our managing editor of User News, looks at two products for the IBM PC that make an attempt at understanding English. These are CLOUT, from MicroRIM, which works with files created with R:Base database-management programs, and SALVO, a self-contained database-management program that features a natural-language query system. George answers the questions that these two programs cannot answer: What can these programs really do? And which one is better?

Finally, Bill Jacobson reviews two relatively new relational database-management programs, again for the IBM PC. In a fairly detailed comparison, he measures DataEase against Condor 3 and dBASE II, two older, established database-management systems.

—*Rich Malloy, Product-Revew Editor*

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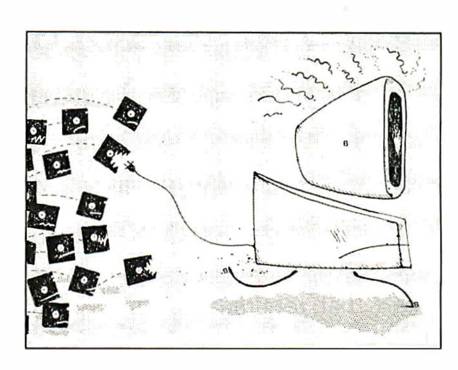
PARIS







AT&T



IT IS AMAZING how programmers seem to be squeezing more and more performance out of the 8088 microprocessor in the IBM Personal Computer (PC) and its compatibles. The first programs for the IBM PC were apparently converted from CP/M-80 programs and took little advantage of the 8088's increased address space and power. Now, three years after the IBM PC was first announced, not a month seems to go by when a new program does not appear that attempts to turn the PC from an expensive show horse into a thoroughbred.

One of the latest such programs is XyWrite from XyQuest, a small company in Bedford, Massachusetts, composed of some of the same people who developed the Atex editing/typesetting system. It seems that the XyQuest people have done an admirable job porting the editing part of the Atex system onto IBM PC-compatible systems. XyWrite II Plus, which sells for $300, was written in assembly language and is extremely fast, powerful, compact, and flexible.

A few of the notable features include: fast scrolling; improved scrolling on the IBM color monitor (no flicker of "snow"); mail-merge capability; and the ability to do microjustification (i.e., expanding a printed line by adding small spaces between each character). More features will be listed in the upcoming review.

Of course, all is not perfect. XyWrite's documentation could benefit greatly from a complete rewrite. And the Help screens contain information that is organized in a somewhat less than intuitive manner. But if you don't like the Help screens, at least you have the option of writing your own.

The other way to get increased performance is to change the hardware. Two IBM compatibles recently arrived here sporting the 80186 microprocessor, a fast chip that is compatible with the IBM PC's 8088 chip.

The first is MAD (Modular Advanced Design) from MAD Computer Inc. of Santa Clara, California. The MAD machine, which sells for $3360 in the BYTE standard configuration (two floppy-disk drives, 256K bytes of RAM [random-access read/write memory], monochrome monitor, color capability, serial and parallel interfaces, and BASIC), looks like a European stereo set, but it can really perform. The MAD ran our spreadsheet-recalculation test in half the time of the IBM PC. Its innovative, compact design allows only one IBM-compatible expansion card, but most software is compatible. We haven't received MAD BASIC yet, and we are not sure about the service supplied by this small company, but so far it looks like an impressive machine.

Our second 80186 machine is the STM-PC Portable, from STM Electronics, a Canadian-based company that has previously brought us the Pied Piper, a transportable CP/M system. The new STM transportable features not only the 80186 and IBM compatibility, but also a 25-line LCD (liquid-crystal display), 256K bytes of memory, and a 1200-bps (bits per second) internal modem with a speaker phone—plus a 40-column thermal printer and dual 720K-byte floppy-disk drives, and the NewWord word-processor program. All this sells for $3449.

Unfortunately, the machine we received has ordinary 360K-byte floppy-disk drives that write data at a track density of 48 tracks per inch (tpi) instead of 96 tpi as in the 720K-byte drives.

This machine is a lot smaller than the usual sewing-machine-sized transportables, but it is not really a portable, unless you are willing to carry around a 110-volt AC generator.

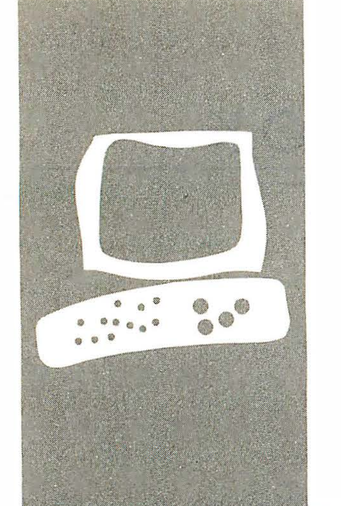
The 25-line LCD is from Epson (which suggests interesting possibilities) and is Flight Simulator compatible. The display is also backlit with an electroluminescent panel. But because the display has a rather flat aspect ratio, and because the contrast of the LCD is not very high, text characters can be hard to read. Also, in some software the cursor disappears.

In addition to the above supercharged systems, we have also received a few IBM compatibles with fairly standard 8088 chips. These include the Televideo Color PC and the ITT Xtra. The Televideo unfortunately features only one expansion slot, and it does not allow you to add an additional monitor or to adjust the brightness of the internal color RGB (red-green-blue) monitor. The ITT features an interesting communications program as part of its version of the MS-DOS operating system.

A month or two ago, I discussed our interest in getting a Zenith Z-150. We received the machine and it works well, but it did not come with any of the superior Zenith operating system software for which the Z-100 was acclaimed.

And one more note, while we are speaking of clones. We finally received the Columbia MPC VP portable. But again, no software was included. And the machine seems to blank itself out periodically. Oh well, you can't have everything.

—*Rich Malloy, Product-Review Editor*



S·Y·S·T·E·M R·E·V·I·E·W

The Fujitsu Micro 16s

Adaptability is its greatest strength

BY ALEX POURNELLE

Japanese products have won a reputation for high reliability and quality. From cars to cameras to printers, their exports cannot be dismissed as "cheap." Fujitsu, Japan's largest computer company, is trying to extend that reputation with its Micro 16s microcomputer (see photo 1).

Designed by an American team in the Silicon Valley and built in Japan expressly for export to the United States, the Micro 16s has some truly distinguishing features. First and foremost is its obsolescence protection. Fujitsu will make plug-in cards with new processors as they become popular. These cards go in a Fujitsu-designed bus that is incompatible with any other bus. Second is the company's decision to supply CP/M-86 as the standard operating system, with MS-DOS as an option (opposite to IBM's strategy). Finally, the 16s *isn't* IBM hardware compatible—it is an honestly different machine.

Fujitsu has targeted the 16s as a business computer. Indeed, it is likely to do best there because of its speed and reliability. However, software developers might use it as a compiling engine: it's fast, expandable, and seems very reliable.

Desk Space

Most microcomputers are designed to sit on or near a desk. This has led to machines with very small footprints; that is, they take up little desk space or parts of them can sit on the floor. The 16s's footprint is about that of the IBM PC's and larger than an HP 150's or Tandy 2000's. Fujitsu did this with a reason in mind: the motherboard, expansion slots, and power supply are large to accommodate later additions. The 16s can be placed vertically on the floor and used with longer cables, but only with the right-hand side up—that's where the Reset button and power switch are.

Hardware

Physically, the system unit is a solid computer, weighing in at 33 pounds less disk drives. Its fan runs extremely quietly. I had only a few complaints about engineering: the screws holding the internal drives and boards were difficult to reach; the keyboard plug is on the back; few chips have sockets. No chip sockets means fewer connection-related failures, but it also means dealers must keep a stock of complete main boards for even minor chip failures.

The 16s's keyboard is a little different from any other (see photo 2). The alphanumeric keys on the left are laid out exactly as if a Selectric II keyboard were transplanted to a computer. Its familiar layout, down to the large Return key, is a refreshing change from the IBM PC's and DEC Rainbow's rearrangements of the most popular keyboard for offices.

I think that the 16s's keyboard feels too plastic and thin, but everyone else I know who used it liked it. The keyboard does seem fast and responsive to the touch. It has a 16-character type-ahead buffer managed by the 68B09 housekeeper microprocessor on the motherboard. Hardware type-ahead, which lets you type characters during disk access, is addictive. You can enter several commands without waiting for the next prompt.

The KCLICK program turns an audible keyclick on and off. You can use it with an AUTOEXEC.SUB file that is executed on start-up. Similarly, the function keys can be defined at start-up. Under CP/M-86, their definitions appear on the twenty-fifth line of the display. The default definitions are sensible; for example, PF1 and PF2 run the SDIR superdirectory program for drives A and B.

Those editing keys between the alphanumeric keys and the numeric pad work within the operating system and in WordStar. The Delete key deletes one character to the left, for instance. The other keys produce similarly mnemonic results, although their actual control codes must be changed for different programs. This attention to detail is to be commended.

Alex Pournelle is chief programmer for Workman and Associates (112 Marion Ave., Pasadena, CA 91106), a software publisher. He also attends the University of California at San Diego and is collaborating on a textbook.

The unusual layout of the cursor-control keys was hard for me to get used to. I wish Fujitsu would exchange it for a more conventional layout. The Quote key (next to the right-hand Shift key) produces a normal double quote. The Break key handily produces a Control-C that can terminate some programs. Like the IBM PC, the 16s can be reset by simultaneously pressing the Control, Alt, and Delete keys. This won't work if the computer isn't looking at the keyboard. This is why the 16s has a Reset switch, which the IBM doesn't.

VIDEO DISPLAY

An RGB (red-green-blue) color monitor is optional with the 16s. Its display is extremely readable. Small holes in the rear of the monitor lead to adjustment controls, but I never needed them. The brightness control in front was enough. A minor flaw is that the RGB and light-pen sockets use identical DIN (Deutsche Industrie Norm) sockets.

I surmise from the hardware manual that any standard NTSC (National Television System Committee) monochrome monitor should plug into the "green CRT" socket with an adapter cable. I don't know if more than one monitor can be used at a time. The RGB monitor isn't hard on the eyes, but the option of color or monochrome is there. Both text and graphics displays are steady from screen warm-up through a 16-hour day. Graphics are displayed as 640 by 200 pixels (dots) with 8 colors. Monitors with variable intensity will show 16 colors. Simultaneous displays of text and graphics overlap rather than overwrite each other. Graphics and text have their own memory areas, according to the hardware manual. I don't know if application programs can access them directly.

Any character can be displayed in any one of the eight primary colors over any background color. This can be set with the supplied Screen program. The background can be set blinking—good mostly for attention-getting. Screen can also display a 24-hour time clock in the upper right corner of the screen.

HARDWARE OBSERVATIONS

When you start up the 16s, it quickly checks what boards are installed and lists those it finds. It doesn't actually check each drive, so if you have an interface installed and no drives, it wouldn't know. If you then try to access those nonexistent drives, the system can lock up.

The built-in, four-channel A/D (analog-to-digital) converter is documented in the hardware manual, but that's about it. Fujitsu has made no plans to provide software support for this connector; for the moment, it's just there. Hobbyists could probably hook up a joystick or bit pad with no trouble at all, but they wouldn't get much help from Fujitsu.

One boon for hobbyists and experimenters is that Fujitsu will sell listings of its

(continued)



Photo 1: *The Fujitsu Micro 16s and an optional 13-megabyte 5¼-inch hard-disk drive.*

CP/M-86, CCP/M-86, and MS-DOS BIOSes (basic input/output systems) for $100 each. While this price is a little bit high, I applaud Fujitsu's decision to sell listings. Some of the best equipment around has been developed in homes on unremarkable micros. BIOS listings make this much easier.

INTERNAL STRUCTURE

Inside, the 16s looks much like any other computer, except for its expansion boards. The boards use a bus designed by Fujitsu specifically for the 16s. This bus has a data path 16 bits wide (twice the width of the IBM PC's, the same as the S-100/IEEE-696) and an address path 24 bits wide. In addition, provisions have been made for multiple processor boards.

Unlike the S-100/IEEE-696 bus, voltage regulation is handled in the power supply, leaving more room for functions on the expansion boards. Like the European/Motorola VME bus, the 16s's bus uses a socket on each board, mating with pins sticking up from the motherboard. This arrangement is supposed to be more reliable than the familiar card-edge and socket-on-motherboard arrangement of the IBM PC and S-100 buses.

The 16s has only six slots (plus one for the 5¼-inch disk-drive controller). But notice the functions already supplied: an RS-232C port, a Centronics printer port, and the keyboard interface are all standard. The monochrome and color interfaces are also standard—and don't take up an expansion slot. So the "standard" 16s will have four empty slots. If you run out of room, you can remove the Z80A processor board and replace it with an 8-inch disk controller. Or you can replace the 8086-2 board with a more advanced processor, when available. All this can be done with full manufacturer support.

The novel bus arrangement has one side effect: it's difficult to insert or remove expansion boards. It's so hard, in fact, that I feared for the traces on the motherboard while reinserting the 8086-2 board (although the computer seemed none the worse for wear). The hardware manual described a pair of 9-inch-long L-shaped metal brackets for pulling boards. Dealers are supplied with these.

The 16s's unique bus provides food for thought: since only Fujitsu is likely to make boards for the 16s, you may not get the ones you need if the demand is light.

PERFORMANCE

The 16s is fast. It has an 8086-2 microprocessor (the 2 is for 8 MHz) for 16-bit (CP/M-86 and MS-DOS) programs and a Z80A for 8-bit (CP/M-80) ones. The 8086 has 16-bit data paths. In the Fujitsu Micro 16s, the 8086 runs at about twice the speed of the IBM PC's 8088 microprocessor.

The correct processor is selected automatically for each application by Fujitsu's version of CP/M-86. The programs supplied with the computer worked just fine, except for Digital Research's DR Graph. WordStar, SuperCalc2, and the supplied utilities ran quickly and reliably. Even WordStar's tiresome overlay swapping ran fast, probably because of the 16-bit data paths on the Fujitsu's bus.



Photo 2: *The Fujitsu keyboard.*

MEMORY

Fujitsu currently offers four different memory boards to supplement the standard 128K bytes on board, which I believe is far too little for a business machine. I received and installed the 256K-byte board, which ran fine. After setting switches on the 256K-byte board to address it above the internal 128K bytes, I put it in place and ran the supplied Health Check program. No switches are on the 16s itself to set for added memory. It automatically finds the amount of installed memory when started.

The 256K-byte board is well built, and its chips stay cool to the touch while running. It uses 64K-bit RAMs (random-access read/write memories), as does the 128K-byte memory board. The 1-megabyte board uses 256K-bit RAMs. Because these RAMs are new and scarce, this board is expensive. Currently, the maximum addressable RAM is 1 megabyte, which is a limitation of the 8086.

Whatever memory is installed can be partitioned between working RAM and a RAM disk (i.e., an area of memory that looks to the computer just like an extremely fast disk drive). The RAM disk makes compiling and file-sorting functions much faster.

Running the Health Check program uncovered the first of several software bugs: it won't run under CCP/M (Concurrent CP/M-86). Instead, it gave the message, "Illegal call of interrupt 1A," printed another A prompt, and then the 16s promptly died. It seems that

(continued)

AT A GLANCE

Name
Fujitsu Micro 16s

Manufacturer
Fujitsu Microelectronics
3320 Scott Blvd.
Santa Clara, CA 95051
(408) 727-1700

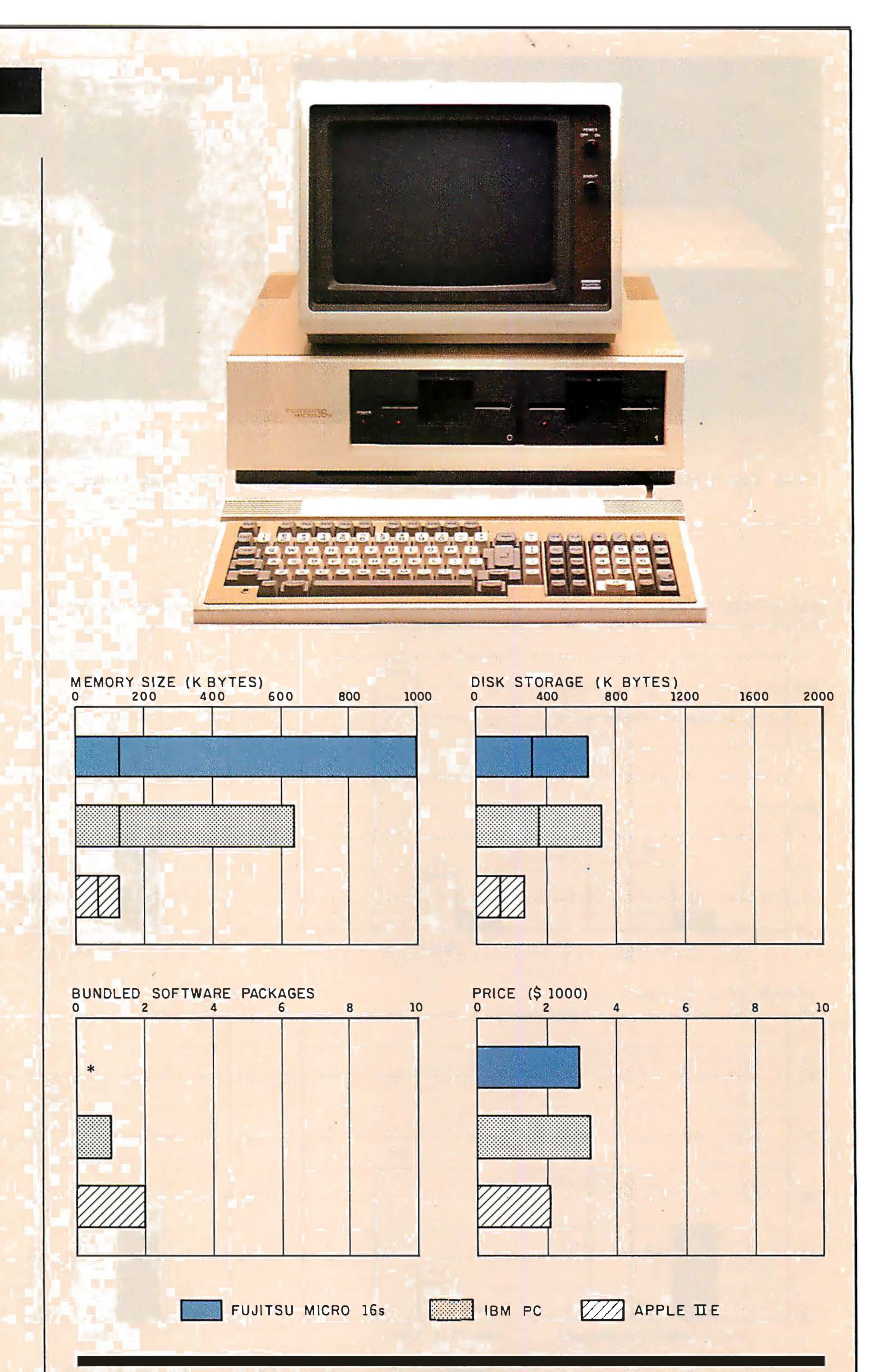
Components
Size: main system unit is 19¼ by 14½ by 5¾ inches
Weight: 33 pounds
Processors: 16-/16-bit 8-MHz 8086-2 and 8-/8-bit 4-MHz Z80A; an 8-/8-bit 2-MHz 68B09 controls housekeeping on the motherboard
Memory: 128K bytes
Display: 12-inch monochrome or RGB color monitor; 80 characters by 25 lines; 640 by 200 color graphics
I/O interfaces: one RS-232C serial port, one parallel printer port, a four-channel A/D converter, monochrome and RGB color-monitor interfaces
Mass storage: two 5¼-inch double-sided double-density floppy-disk drives, 320K bytes each
Expansion capability: seven expansion slots; standard system requires three slots

Price
Standard system unit: $2350

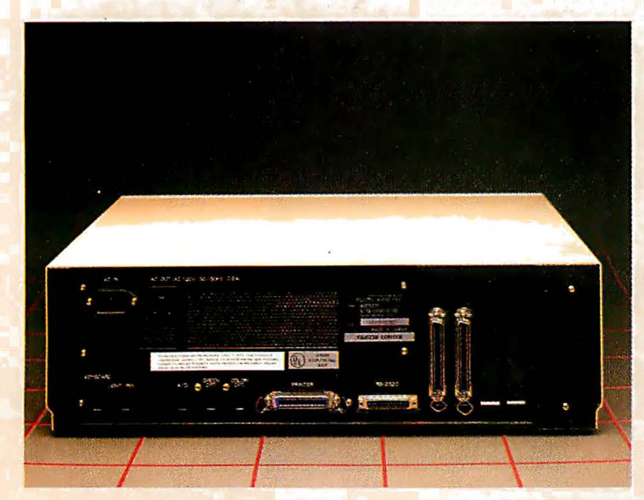
Optional Hardware

SCSI/hard-disk controller card:	$295
13-megabyte 5¼-inch hard-disk drive and controller:	$1995
26-megabyte 5¼-inch hard-disk drive and controller:	$2895
128K-byte memory board:	$295
256K-byte memory board:	$495
512K-byte memory board:	$1195
1-megabyte memory board:	$2095
Serial RS-232C interface (two ports):	$395

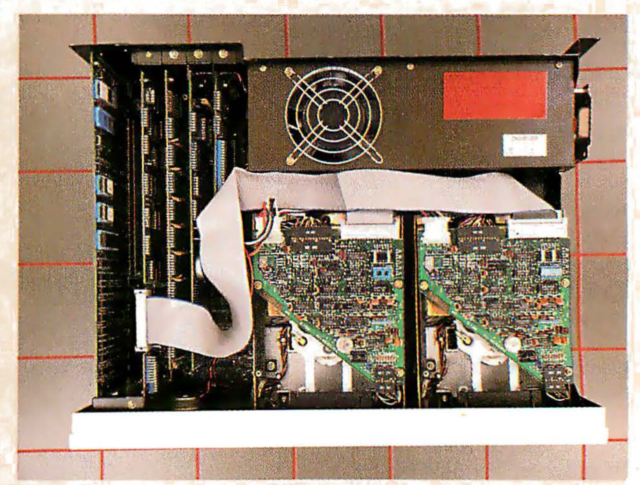
Documentation
Operations Guide, 62 pages, covers the basics of assembling and operating the computer; an optional hardware reference manual ($75)



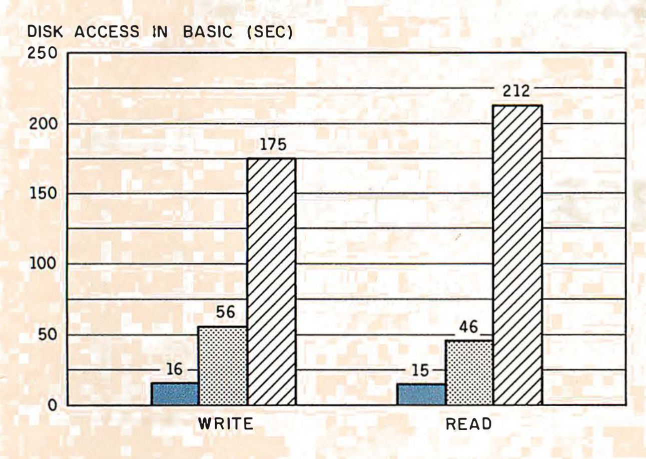
The Memory Size graph shows the standard and optional memory available for the computers under comparison. The graph of Disk Storage capacity shows the highest capacity of a single floppy-disk drive for each system. The Bundled Software Packages graph shows the number of software packages included with each standard system. The 16s is not normally sold with bundled software. The Price graph shows the Fujitsu Micro 16s list price (including CP/M-86, monochrome monitor, and 256K bytes of RAM) compared to systems with two floppy-disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port, 256K bytes of memory (64K bytes for 8-bit systems), the standard operating systems, and a BASIC interpreter for each system. For details of the Fujitsu Micro 16s specifications, see the configuration details in the "At a Glance" listing.

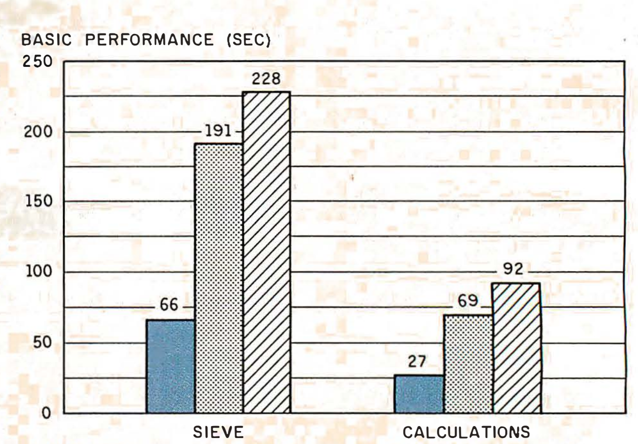


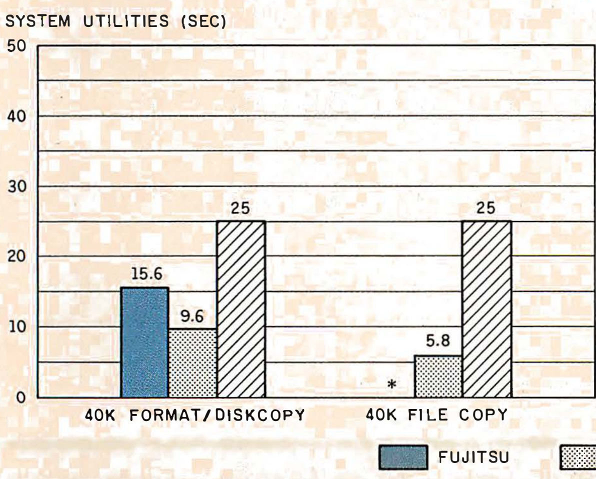
A rear view of the Fujitsu Micro 16s.

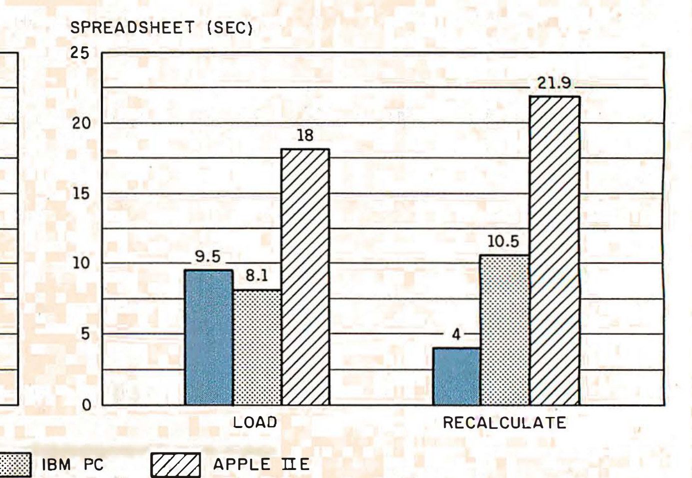


This interior view shows the unique Fujitsu motherboard with several cards installed.









FUJITSU IBM PC APPLE IIE

The graphs for Disk Access in BASIC show how long it takes to write a 64K-byte sequential test file to a blank floppy disk and how long it takes to read this file. (For the program listings, see "The Chameleon Plus" by Rich Krajewski, June BYTE, page 327, and the revised listing in Fixes and Updates, page 33 of this issue.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The System Utilities graphs show how long it took to format and copy a disk (adjusted time for 40K bytes of disk data). (*The 40K-byte file transfer was not performed.) The Spreadsheet graphs show how long the computers took to load and recalculate a 25- by 25-cell spreadsheet, where each cell equals 1.001 times the cell to its left. The Apple and IBM used Multiplan; the Fujitsu used SuperCalc2.

some serious software differences exist between CP/M-86 and CCP/M.

Documentation

The single manual that comes with the 16s isn't enough. It covers only portions of the included software. First-time computer users will find this manual woefully inadequate. I would be much happier if Fujitsu supplied a more detailed introduction to computers for novices covering such items as disk care and computer power requirements.

Most of the optional manuals are reprints: the CCP/M-86 manual is just a Digital Research manual with a 16-page insert about the 16s. The CP/M-86 manual's index doesn't list such important utilities as SDIR, Screen, and Setbaud. I found no mention of how to run CP/M-80 programs. BDOS (basic disk operating system) functions are referred to as DBOS functions throughout one section. However, Fujitsu has made serious improvements over the photocopied manuals I originally received. The 16s manuals are only slightly worse than, say, the IBM PC-DOS 1.1 manual.

The manuals for add-on hardware are much better than those for software. I am impressed by the manual for the hard-disk controller.

CP/M-86

Almost everyone will run CP/M-86 on the 16s. It is a hybrid system, running both 16-bit programs (CP/M-86) and some 8-bit ones (CP/M-80). Several other computers, notably the DEC Rainbow, CompuPro 8/16, and Zenith Z-100, also switch automatically between their two processors, but I'm afraid they do a much better job. I couldn't find a single alternate 5¼-inch CP/M-80 floppy-disk format that the 16s could read properly except for CP/M-86 IBM PC format. This alone will make it hard to run 8-bit programs. In addition, several of the CP/M-80 applications I tried didn't run on the 16s, specifically, programs that did BIOS calls. Fujitsu's engineers promised that they would look into this.

Fujitsu has paid attention to detail. The supplied utility programs will set the time, update it constantly on the screen, check the health of the 16s, and program the function keys. WordStar's Install program lets you change the colors in which text will be displayed. Fujitsu supplies an entire disk of on-line Help information, customized for the 16s, and blank disks to back up the supplied software.

Some gaps still are found, however. A backup program that will format, copy, and verify a disk with one command is needed. The entire computer locks up when you attempt to print to a nonexistent printer. CP/M-86 needs to support user numbers and disk-search lists more thoroughly. Also needed are programs to transfer data between CP/M and MS-DOS and a way to read different CP/M-80-format disks.

The 16s doesn't come with a BASIC. Claudia Natalia, the Fujitsu Micro 16s press-relations supervisor, says that the business marketplace doesn't need or want BASIC.

CCP/M-86

Fujitsu's implementation of CCP/M-86 is well done. You can set up four different programs to run under CCP/M; for example, WordStar, SuperCalc2, a communications program, and a time manager. Each would wait for you to switch to its task, meaning you could have an entire set of your normal work programs set up for you. With the 16s's 8-MHz 8086, this would also run acceptably fast.

CCP/M works with most CP/M-86 programs and uses the same hard-disk partitions that CP/M-86 does, so you can switch freely between the two by just restarting the 16s. Unfortunately, it doesn't run 8-bit (CP/M-80) programs at all. A Fujitsu engineer told me that the Micro 16s would have to stop running 16-bit programs for the entire time that 8-bit ones were executing.

The CCP/M manual includes a large gap. The Fujitsu insert for the front of the CCP/M manual didn't mention how to switch tasks! An engineer filled me in: press the Graph key and the Numeric Pad key corresponding to the task you wish, from zero through three.

MS-DOS

I reviewed a preliminary copy of MS-DOS, so I can't comment on it as much as CP/M-86. The 16s uses the full MS-DOS version 2.0 in a double-sided nine-sector format. Disks made on the 16s read and write fine in the IBM PC. It will also make eight-sector disks, both single- and double-sided. Naturally, MS-DOS won't run many programs that are extremely IBM hardware dependent, but WordStar and SuperCalc2 (as supplied) work just fine.

A few highlights: MS-DOS also gets its time from the real-time clock on the hard-disk board, although you must press the Return key to confirm it. The Screen utility will set colors, clock placement, etc., just as under CP/M-86. Help under MS-DOS isn't as complete as under CP/M-86.

GSX-86

GSX-86 is a Digital Research program supplied with the 16s that attempts to make graphics transportable. Data gathered on one computer should work on any other, both for display and output. Its companion product is DR Graph, which actually does the graphing.

DR Graph is rather slow, both to load and to display graphs, even with the high speed of the 16s. It's fragile, must be loaded after GSX-86, and used with the Run utility, or it will lock up the computer. It lacks many features, such as a way to display the directory from within DR Graph. It's not well tested; the message "press any key" actually means "press the Return key." It does make readable graphs.

Expansion Hardware

I received two subsystems for review with the 16s: the dual 8-inch floppy-disk drives (no longer offered as an option) and the 13-megabyte hard-disk drive.

Many computers still use 8-inch drives, and the "IBM standard" 3740/1 single-sided single-density disks are

(continued)

New processor cards will keep the 16s current for many years to come.

still the only truly universal medium. True, IBM PC-DOS 5¼-inch disks are a close second, but most software-development companies still use 8-inch-drive machines. This is true at Chaos Manor, too.

The subsystem contains two half-height 8-inch drives that are double-sided. An interface card plugs into the 16s. Once installed (in about 15 minutes), I could use normal 8-inch CP/M-80 disks without difficulty. The drives became C and D, and programs, such as CRCK, that don't use BIOS calls work fine. They read, write, and format SSSD (single-sided single-density) disks using the Format program.

The 8-inch-drive interface seems to be standard except for the unique connector, which resembles a 50-pin Centronics connector. Fujitsu *will* sell just the drive-interface board, so you can hook up your own drives and save a lot of money. The hardware manual and Fujitsu confirm that it's a standard 8-inch interface. With the hardware manual, some connectors, wire, and a soldering iron, you can make an adapter cable for any 8-inch double-sided drive.

Software modifications *would* be required for using more than two 5¼- or 8-inch drives, even though there is an "out" connector on the 8-inch drives where you could hook up another pair.

I also tested the 13-megabyte hard-disk-drive subsystem. Again, this comes in two parts: an interface board that plugs into the computer and the hard-disk drive and another interface in a separate cabinet.

The interface is an SCSI (small computer standard interface) board. This is a standardized superset of the older SASI (Shugart Associates standard interface). The SCSI board plugs into the expansion bus and has another 50-pin connector on the rear of the 16s. The board I received was an early model with a number of jumper wires and resistors. Later ones are supposed to be free of these hand-wired modifications.

The SCSI board also contains a battery-backed-up real-time clock. Mine had a wire-wrap area, I guess for experimental interfaces. This area has been removed from current SCSI boards.

You can also choose to buy only the SCSI board and connect up to four of your own hard-disk drives. You'll also need an adapter to connect them to the SCSI/SASI board, plus a cable adapter for Fujitsu's unique connector. This do-it-yourself option is only for the patient and knowledgeable, but it could save a lot of money.

One bit of connector confusion: the cables for the 8-inch floppy-disk and hard-disk drives are identical 50-pin versions of Centronics connectors. Both the 8-inch and hard-disk-drive cables should be labeled.

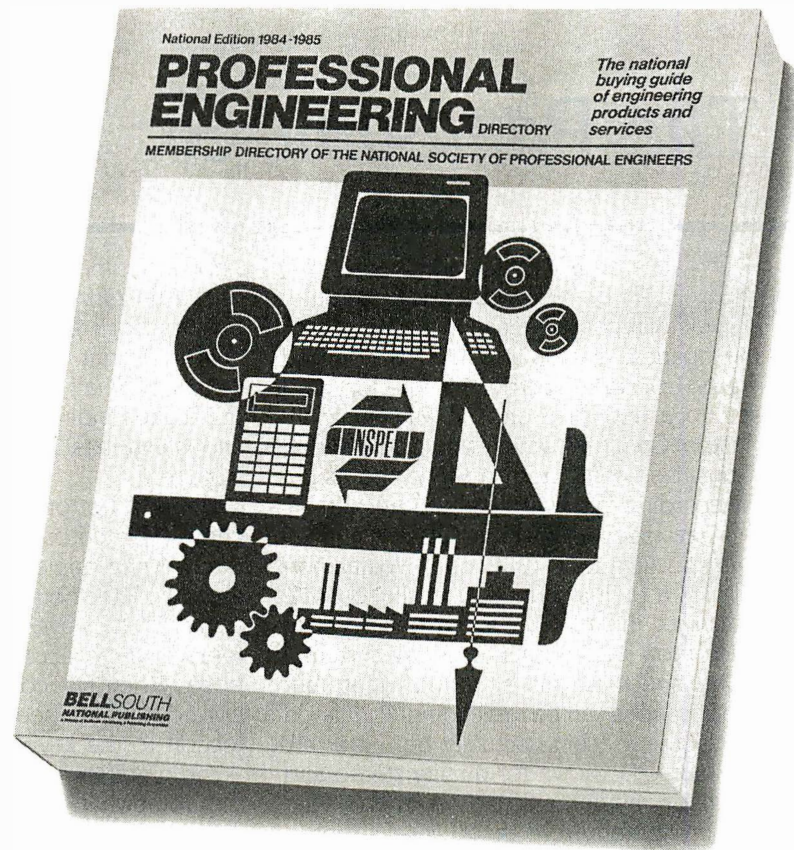
Summary

I like the Micro 16s's hardware. Everything is extremely well built. New processor cards will keep this machine current for many years to come. The large memory cards, high-bandwidth bus, and expansion boards should be the standard for other microcomputers.

The 16s will run some CP/M-80 programs and most CP/M-86 ones that don't rely on non-16s hardware. A wide range of software is available, especially in the IBM PC and CP/M-86 formats. MS-DOS for the 16s is well done, and my experimentation with CCP/M-86 impressed me. The staff at Fujitsu seems a bit disorganized but very knowledgeable. They are certainly attentive to customer needs.

The only real detraction to buying the 16s is compatibility. It isn't an IBM PC. Its unique bus means buying boards exclusively from Fujitsu. Much of the 16s's greatest potential awaits the introduction of more advanced processor boards, using microprocessors such as the 68000 or the 80286. Still, the Micro 16s is simply too good to be ignored. ■

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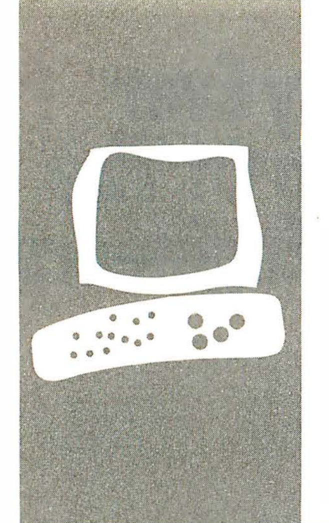
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SYSTEM REVIEW

The Panasonic Sr. Partner

The IBM PC-compatible portable that packs its own printer

BY RICH MALLOY

Several months ago we received a call from yet another new computer company. Panasonic, a branch of the Japanese giant, Matsushita (pronounced "mat-SUSH-ta") Electric Corporation, had set up a new division, the Panasonic Industrial Company, which would be offering a business computer on these shores.

According to the company spokesperson, this new machine would have some impressive specifications: IBM compatibility, portability, a built-in printer, and six software packages included in a reasonable base price (now $2145 for a one-disk system).

The specifications sounded great, but specifications can be misleading. How good would the machine actually be? After all, Panasonic is known for quality stereo and television equipment, but we hadn't seen any computers from them, at least not in this country. And just *how* compatible would it be with the IBM Personal Computer?

FIRST LOOK

Like the old Osborne I, the Compaq, and other transportable computers, the Panasonic Sr. Partner resembles a sewing machine when it is bundled up for travel. It is, however, a bit smaller than the Compaq (19 by 13 by 8½ inches versus the Compaq's 20 by 15⅗₀ by 8 inches), and it has a nice padded handle on its left side. Like most transportables, the keyboard attaches to the front of the machine, protecting the display and the disk-drive openings. A removable panel on the back of the machine protects the power cord, the fan openings, and the interface connectors.

In the Sr. Partner's open, "ready to work" configuration, its keyboard is attached to the main system unit by a short coiled cable that plugs into the rear of the keyboard. This cable extends about 2½ feet and allows you to place the keyboard comfortably on your lap, although you won't be able to sit too far away from the computer.

The Sr. Partner's display measures 8½ inches diagonally and is of the green-phosphor type. It is located on the left side of the unit's front panel, a fairly standard position for transportables.

On the right side of the front panel are one or two half-height 5¼-inch floppy-disk drives, depending on the configuration you choose. It has no space for floppy-disk storage.

On the bottom of the machine is a chrome-plated bar that flips down to raise the viewing angle. Most other transportables (with the notable exception of the IBM Portable PC) have short legs that can be folded out to accomplish this same purpose. When the computer is being transported, this bar seems to offer some protection to the keyboard.

The on/off switch for the Panasonic is in the somewhat traditional, if nonsensical, position on the back panel. Sharing this rather inaccessible location is the brightness control for the display. Thus, turning the machine on or off or adjusting the brightness of the screen involves a lot of fumbling with your fingers on the back panel.

Also on the back panel, and with more reason for being there, are the machine's serial connector (female, DB-25), a Centronics-type parallel printer port, and an RGB (red-green-blue) connector (9-pin, IBM PC style). A narrow metal plate on the left side of the back panel can be removed to provide access to expansion boards that have an external connector, such as a serial communications card.

On top of the machine is a small rectangular plastic panel, which, upon removal, reveals the most significant feature of the Panasonic Sr. Partner: its 80- or 132-column thermal printer. The printer is amazingly small, even though it includes space for a small roll of about 70 sheets of 8½-inch-wide thermal paper.

THE DISPLAY

As mentioned above, the Sr. Partner has a 8½-inch, green-phosphor display (see photo

Rich Malloy is BYTE's product review editor. He can be contacted at POB 372, Hancock, NH 03449.

2). The characters on this display are similar to those on the Chameleon or on a non-IBM monochrome monitor connected to the IBM color/graphics adapter board in the IBM PC. In other words, they are not as sharp as those on the IBM monochrome monitor, or the Compaq or Corona PC for that matter. The reason is that the characters are composed on an 8- by 8-pixel matrix. When you take into account intercharacter and interline spacing, the characters are made up of only 7 by 6 pixels, which is rather coarse, but this cell size is the most that the high-resolution screen of the IBM PC can accommodate (640 by 200 pixels).

While the Sr. Partner comes with a monochrome monitor, it will also support an external RGB color monitor. The graphics modes of the Panasonic are identical to those of the IBM PC, that is, 640 by 200 pixels with two colors or 320 by 200 with four colors.

Unlike the IBM color/graphics adapter board, the Panasonic circuitry can display colors as shades of gray. This feature is helpful, for example, with programs that display text against a colored background. On an IBM PC, the display looks great on a color monitor, but if you have a monochrome monitor connected to the color graphics adapter, the text may become impossible to read: the colored background is displayed as a hatched pattern that interferes with the patterns of the text characters. On the Sr. Partner, however, the colors are displayed as levels of gray, and as a result, the text is easy to read.

One other thing: the IBM monochrome monitor tends to flicker and look a bit "snowy" when you scroll text. The Panasonic has the flicker, but the snow is gone, which also makes the text clearer.

Overall, the Sr. Partner has a fairly good display. I found, however, that a few hours of reading text on the screen did bother my eyes a little. Panasonic could have improved its product if it had supplied an anti-glare screen and a higher-resolution character generator, as did Compaq.

KEYBOARD

Many of the IBM clones such as the Compaq and the Corona PC have the same exact keyboard, an IBM PC-like keyboard produced by Key Tronic of Spokane, Washington. The Sr. Partner, however, has a different keyboard (see photo 3). I don't have anything against the ubiquitous Key Tronic keyboards (although they do tend to feel a bit "mushy" sometimes), but it's nice to see something different.

The Panasonic keyboard has charcoal gray keys with, unfortunately, the same layout as the IBM PC's. The dreaded Backslash key strikes again. Why don't manufacturers follow the examples of Zenith and the TI Professional Computer? Another bad point

(continued)



Photo 1: *The Panasonic Sr. Partner with optional second disk drive installed.*

is a pair of rather flimsy plastic brackets that elevate the back of the keyboard. One improvement that Panasonic made on the standard design, however, is that certain keys (such as the Return and Shift keys) are larger and easier to find than on the IBM PC.

UNDER THE COVER

Under the off-white plastic casing of the Sr. Partner is a rather standard 8088 microprocessor with a clock speed of 4.77 MHz—the same as that of the IBM PC. Supposedly, a socket exists for an optional 8087, but it's hard to find.

The standard unit now comes with 256K bytes of memory, and additional memory can be added by inserting chips on the memory card in one of the expansion slots (for more on this, see "Expansion"). Up to 512K bytes can be present in the system.



Photo 2: *The display of the Panasonic Sr. Partner.*



Photo 3: *The keyboard of the Panasonic Sr. Partner. Note the oversize Return and Shift keys.*

INTERFACES

The Sr. Partner comes with a Centronics-type parallel printer port and an RS-232C serial port on the back panel. The integral thermal printer is set up as "Line Printer 1" (LPT1) and the external port is set up as LPT2. I had a little trouble getting my word processor of choice (PeachText) to print through LPT2, but it can be done; using most other word processors, it can be done fairly easily. Also, buried in the manual, Panasonic provides a key sequence to switch from the internal printer to the external. All you do is press the Alternate key and the Print Screen key. This sounds pretty logical when you think of it, but I didn't think of it.

As for the serial port, I connected the Sr. Partner to a modem, to a Hewlett-Packard HP-7475A plotter, and directly to other computers. I had no problems. Actually, serial communication is always a *bit* of a problem. But I had no more problems than I have had with other computers.

An RGB connector is also located on the back panel. I used it to connect to a Teknika MJ-22 RGB monitor using a standard IBM cable and the system worked quite well.

THE PRINTER

One of the high points of the Sr. Partner is its thermal printer. This 80/132-column printer is compatible with the control codes used by the Epson MX series printers. It is also compatible with the extended characters used by the IBM PC (see figure 1). We tested its graphics capability by setting up Lotus 1-2-3 for use with an Epson MX-80 printer. Panasonic's printer gave a better picture (figure 2) than many other printers that claim Epson compatibility.

This printer is so small and simple, you may start to wonder why other printers are so comparatively large. Since it is a thermal printer, it is very quiet. It uses shiny white rolled thermal paper, 8½ inches wide (sup-

(continued)

AT A GLANCE

Name
Panasonic Sr. Partner

Manufacturer
Panasonic Industrial Company
1 Panasonic Way
Secaucus, NJ 07094
(201) 392-4261

Processor
16-/8-bit 8088, 4.77 MHz clock rate

Memory
128K bytes on main board; up to 512K bytes with expansion board

Display
8.5-inch, green phosphor, 80 characters by 25 lines, 640 by 200 pixels with two-color graphics, IBM PC-compatible

Keyboard
Detachable, 83 keys, IBM PC layout

Storage
One half-height, double-sided, 5¼-inch floppy drive (360K bytes); second drive optional

Expansion
Two IBM-compatible expansion slots (one designed for memory)

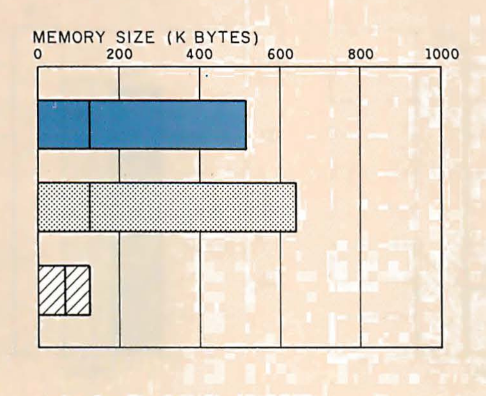
Special Feature
Integral thermal printer, uses 8½-inch-wide thermal paper rolls; text and graphics are Epson-compatible

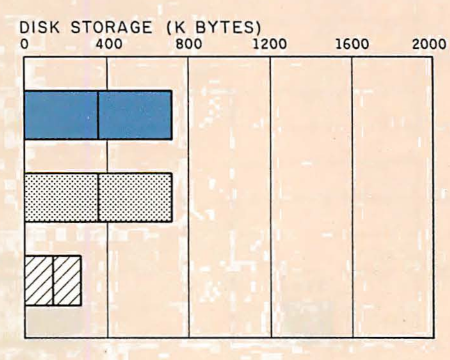
Bundled Software
MS-DOS (version 2.0), GW-BASIC, WordStar, VisiCalc, pfs:File, pfs:Report, pfs:Graph

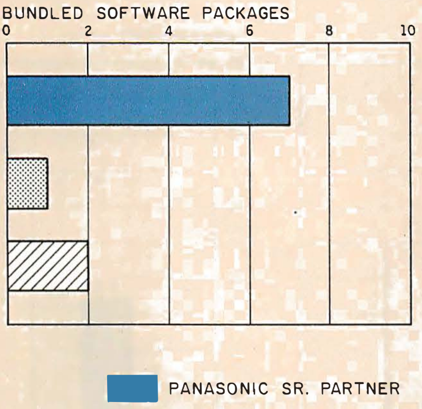
Price
With one floppy drive and 256K bytes of memory: $2145
With two drives and 256K bytes of memory: $2595

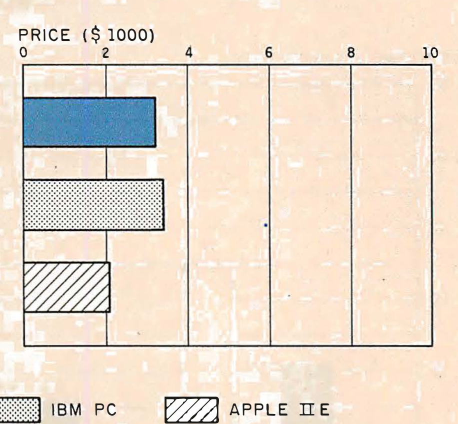
Options
Second disk drive: $450





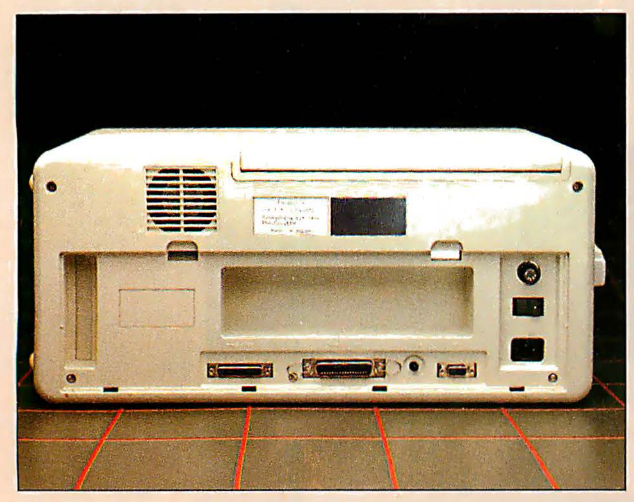




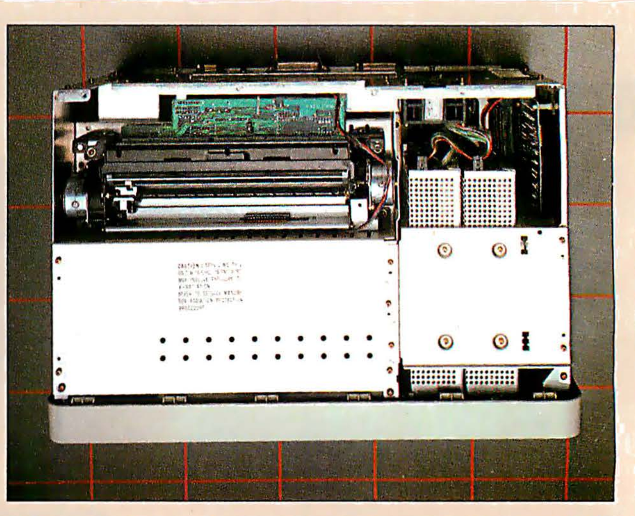


PANASONIC SR. PARTNER   IBM PC   APPLE IIE

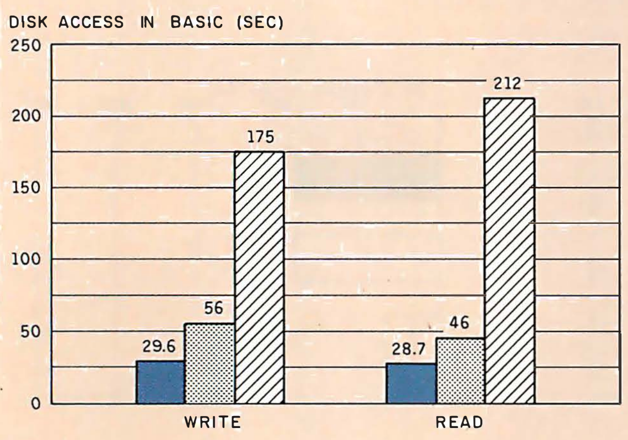
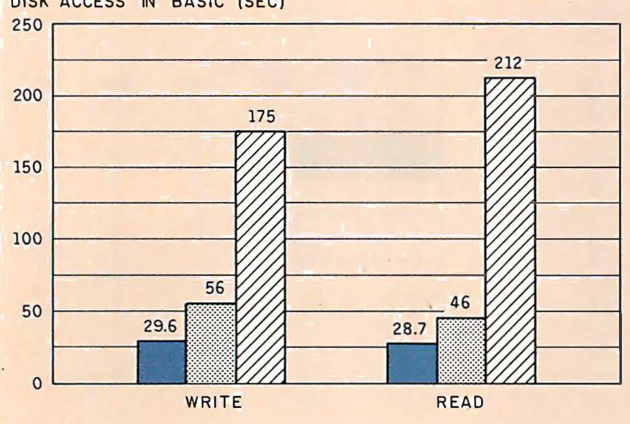
The Memory Size graph shows the standard and optional memory available for the computers under comparison. The Disk Storage graph shows the highest capacity of a single floppy-disk drive for each system. The Bundled Software Packages graph shows the number of software packages included with each system. The Price graph shows the list price of a system with two high-capacity floppy-disk drives, a monochrome monitor, graphics and color-display capability, a printer port and a serial port, 256K bytes of memory (64K bytes for 8-bit systems), the standard operating system for each system, and the standard BASIC interpreter for each system. Note that the Panasonic Sr. Partner also includes a built-in thermal printer.



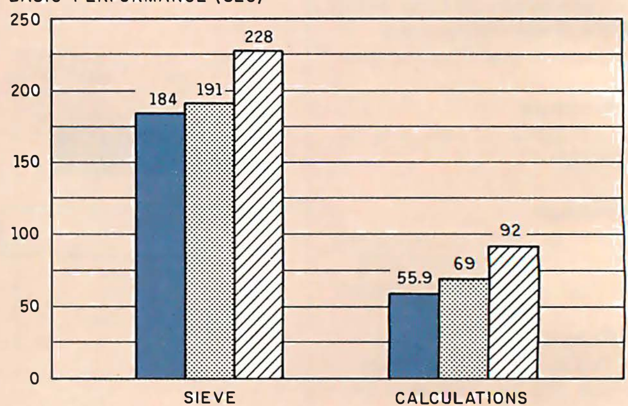
The rear panel of the Panasonic Sr. Partner. Along the bottom are a serial connector, a parallel printer connector, the brightness control for the display, and an RGB color monitor connector. The power switch is on the right. On the left is a removable plate hiding an expansion slot.

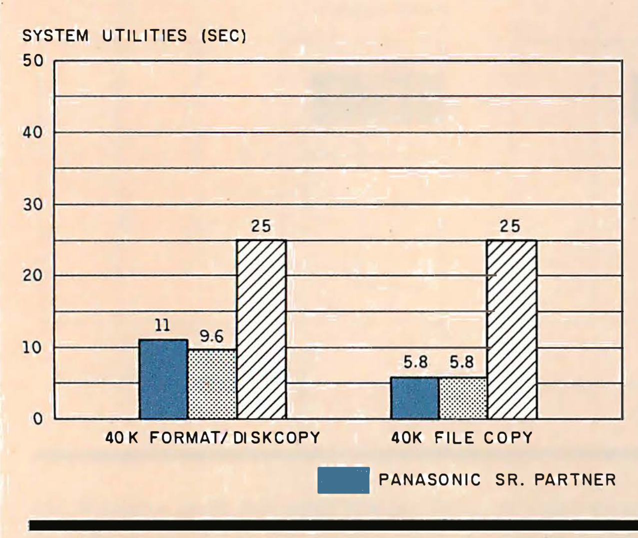


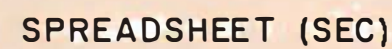
A top view of the Sr. Partner. The printer mechanism is in the left rear corner. The space for the expansion slots is on the extreme right.

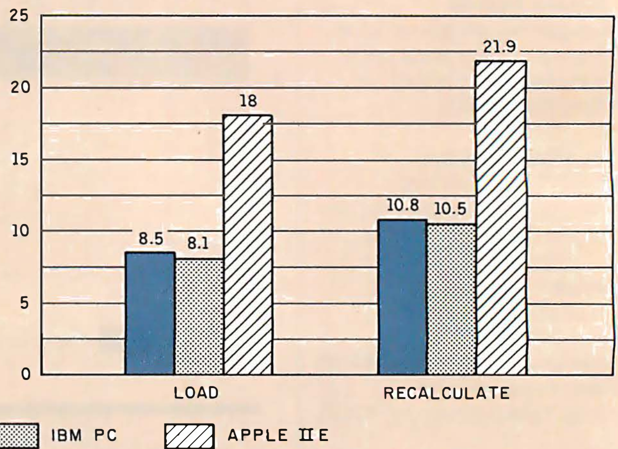













PANASONIC SR. PARTNER   IBM PC   APPLE IIE

The graphs for Disk Access in BASIC show how long it takes to write a 64K-byte sequential text file to a blank floppy disk and how long it takes to read this file. (See the June BYTE, page 334, and the corrected listing in Fixes and Updates, page 33 of this issue.) The Sieve graph shows how long it takes to run one iteration of the Sieve of Eratosthenes prime-number benchmark. The Calculations graph shows how long it takes to do 10,000 multiplication and division operations using single-precision numbers. The System Utilities graphs show how long it took to format and copy a disk (adjusted time for 40K bytes of disk data) and to transfer a 40K-byte file using the system utilities. The Spreadsheet graph shows how long the computer took to load and recalculate a 25- by 25-cell spreadsheet where each cell equals 1.001 times the cell to its left. The spreadsheet program used was Microsoft Multiplan.

posedly available only from Panasonic—$4.95 for a 70-page roll). The vertical dimension of each page is up to you. You can tear off a page anywhere you want using a metal straightedge. (Perforated rolls will also be available.) The printer has only one control—a linefeed button to advance the paper, and only one indicator light—to indicate when you are out of paper. A tiny unlabeled switch under the roll of paper turns on an autolinefeed circuit for software that does not provide a linefeed with each carriage return. Though difficult to reach, this switch is more accessible than that of many other printers.

Of course, this printer is only meant as a draft printer. You're not going to want to print your resume on this. But when you want a quick printout of a memo or a graph, it should fit the bill.

EXPANSION

You give up two things when you go for transportability: display size and expansion capability. As for the latter, the Panasonic offers modest capability. The machine we received had two slots (see the photos on page 258), but one of them is occupied by a memory-expansion card. One of these slots will almost always be used for extra memory. Note that the space for these boards is relatively short—10 inches—compared to the 13-inch length required by most IBM PC boards. This length substantially limits the number of boards that will fit in

Another notable feature is the large bundle of software that comes with the Sr. Partner.

the unit. Fortunately, more and more companies are designing boards to fit in the short slot of the IBM PC XT, which is even shorter than that of the Sr. Partner.

DISK DRIVES

The standard Sr. Partner comes with only one half-height, 5¼-inch floppy-disk drive. The second disk drive is available for an extra $450. Under MS-DOS 2.0, each drive can store 360K bytes of data. The drives are fairly quiet, though not as quiet as those on the Compaq.

SOFTWARE

The other really notable feature of the Sr. Partner is the large bundle of software that comes with it. This bundle includes MS-DOS (version 2.0), GW-BASIC, WordStar (version 3.3), VisiCalc (the VisiCorp version), pfs:File, pfs:Report, and pfs:Graph.

The MS-DOS operating system is similar to IBM's PC-DOS. The BASIC interpreter, GW-BASIC, is very close to IBM's BASICA and is one of the few BASIC interpreters on the IBM PC clones that can run PC-Talk, a good,

(continued)

```
0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G
X Y Z [ \ ] ^ _ ` a b c d e f g h i j k l m n o

@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmno
```

Figure 1: *An example of text characters printed in 10 cpi (characters per inch) by Panasonic's internal thermal printer.*

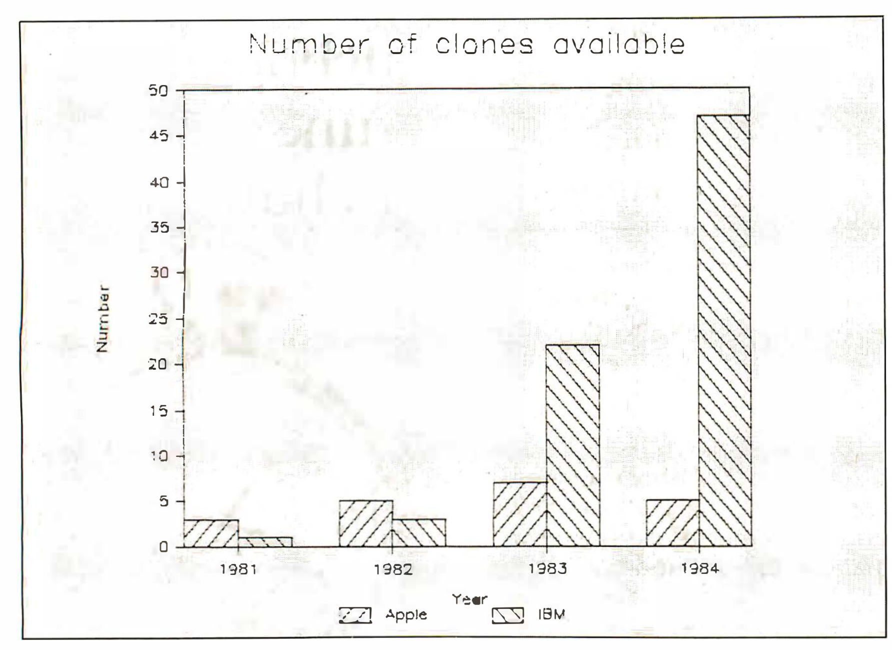
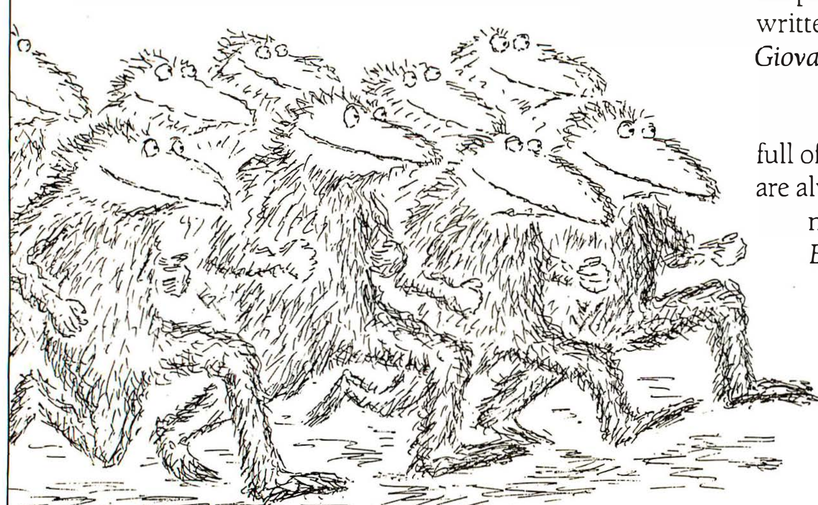


Figure 2: *An example of a graph printed on Panasonic's printer. The graph was produced by* Lotus 1-2-3 *using a printer driver for the* Epson MX-80 *printer.*

The Sr. Partner's closest competitors have similar prices with various software and no thermal printer.

inexpensive communications program written in BASIC (PC-Talk is available from Freeware, POB 862, Tiburon, CA 94920). Unlike the IBM and the Apple II, Panasonic's BASIC interpreter is entirely disk based rather than being resident on read-only memory (ROM) chips.

The other packages, WordStar, VisiCalc, and the PFS series, are good serviceable products, even if they are not exactly on the leading edge of software technology. I have the impression that Panasonic signed the con-



tracts for these packages a fairly long time ago.

Compatibility

No IBM PC clone is 100 percent IBM compatible. The question is, just how compatible is the Panasonic Sr. Partner?

We tried several of the major packages for the IBM PC, and with one exception, they all worked. This group included Multiplan, Lotus 1-2-3, PeachText 5000, Microsoft's Flight Simulator, and several others.

The one exception was part of a keyboard-enhancement package, ProKey. The Layout program in the package, which can be used to redesign the IBM's notorious keyboard layout, does not work. Note, though, that this particular program does not work on any other clone either and that the other programs in ProKey do work well on the Sr. Partner.

Of course, if you need a certain application program, you should first check it on the Sr. Partner to be sure it works. Overall, I must admit that I was impressed with the compatibility of this machine.

Future Expansion

Panasonic has indicated that it will soon offer a number of expansion products. One of these is an expansion box that will have enough room for three standard 13-inch IBM PC expansion boards. This box will be connected to the Sr. Partner by a ribbon cable.

Panasonic is also working on a composite video adapter, a carrying case, and an integral 1200-bps (bits per second) modem.

Summary

The Panasonic Sr. Partner is a good transportable IBM PC clone. At $2595 for a two-drive system, including software and printer, its price is competitive with that of other clones, but keep in mind that you will probably want to buy a second printer for correspondence or heavy-duty printing. The Sr. Partner's closest competition—the Compaq, Corona PC, Chameleon, and the Columbia PCs—have similar prices with varying amounts of software and no thermal printer.

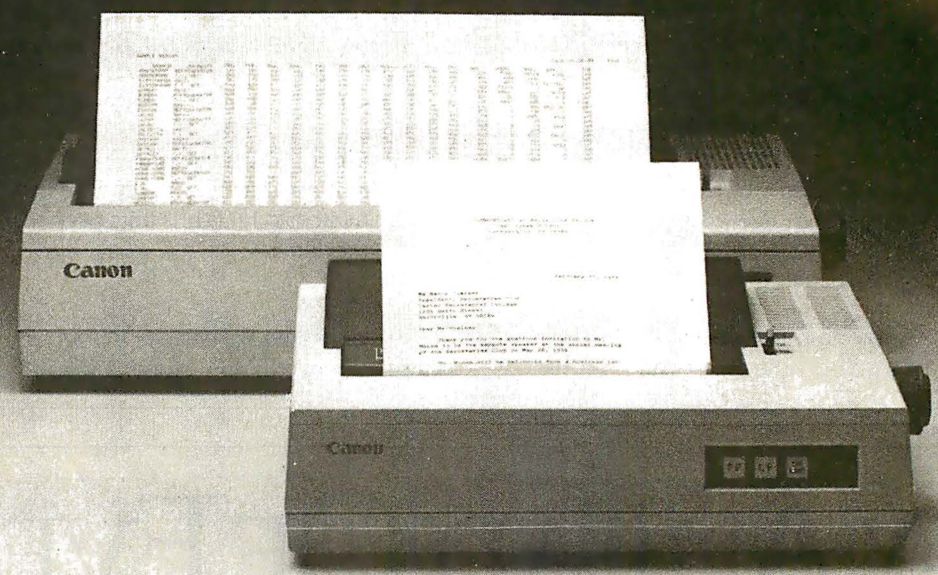
My one hesitation about the Sr. Partner is that Panasonic Industrial Company has no track record for computer servicing and repair. They have, however, set up a network of service centers and a hotline that will allow you to locate the nearest center.

The significant feature about the Panasonic Sr. Partner is its printer. If you need short, draft-quality printouts and graphs in remote locations, then the Sr. Partner may be a welcome addition to your staff. ■



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Canon Printer Division

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SOFTWARE REVIEW

Volkswriter Deluxe

A serious word processor that's easy to use

BY STEVANNE RUTH LEHRMAN

In general, word-processing programs are either flexible or easy to use, but not both. Volkswriter Deluxe is a welcome exception to the norm. Lifetree Software, the publisher, obviously has a clear understanding of its customers' needs. Deluxe is easy to learn and use; anyone that has only an occasional need for word-processing capabilities will be able to get to work quickly. At the same time, the program offers all the formatting and text-manipulation options necessary for serious writing.

Deluxe is also multilingual. You can use it to write in Spanish, French, Italian, and German using the standard American IBM PC keyboard. (The European IBM PC keyboard, including the one sold in the U.K., is different.)

I used Deluxe with both PC-DOS 1.1 and 2.0. In most cases the program worked equally well. My comments in this review apply to both operating systems, but I'll point out any significant differences.

PREPARING DELUXE

Preparing Deluxe for use is comparatively easy. The package provides an automatic set-up utility to transfer files from the original program disk to your working disk. This is a welcome change from the usual process in which you have to figure out which disk belongs in which drive and tell the computer which files to copy.

Configuring Deluxe for your computer is a bit more complex. The initial questions the program asks are simple and take only seconds to answer. (Many programs beep at you when they want your attention, but I find this extremely irritating. With Deluxe, you have your choice—at your command it will beep at you or be silent.)

Deluxe supports 18 different printers and also provides a "generic" printer category for all the varieties not listed. At initial configuration, printer selection is as simple as reading the choices and picking a number.

The final configuration question is the killer; you are asked to define your work habits and preferences. Although you can easily correct your answer if you change your mind later on, Deluxe would be much more friendly, and a whole lot simpler, if the manual prepared you for the question. As it stands, before you know what's happening, you are in over your head.

It is also important that you be aware of Deluxe's "spill file" feature before you begin using the program.

SPILL FILES

Not all word processors can handle long documents, which is a real nuisance for serious writers. And too many programs don't warn you that you have exceeded the document size limit—they just turn unresponsive or may even die when the memory requirements are overloaded. Given 256K bytes of memory, Deluxe can handle 40 pages of text. This is sufficient for an average long report. But Deluxe can also juggle longer files using what it calls a spill file. You may know this function as a "swap file."

Basically, a spill file is a temporary file. The program automatically writes text to it when the memory is full. As you page through a file, the program retrieves the relevant pieces of the document from the spill file. In effect, you use the disk to temporarily add extra memory to your system.

If you choose not to use a spill file, Deluxe will warn you when you are getting close to overload. Then you can divide the document into shorter files. If you expect to write long reports, you will need to establish a spill file. You can set the spill files on a hard disk, a third floppy-disk drive, or on the program disk itself. Do not put your spill files on your data disk. The disk with the spill files cannot be removed during a work session or you risk losing everything on the disk, not just the spill file. (This warning appears on the screen when you boot your program; however, I think Lifetree's warn-

(continued)

Stevanne Ruth Lehrman (15 Larkspur Rd., Newton, MA 02168) is the founder of Analytic Resources in Newton, Massachusetts. Her company specializes in competitive analysis of computer products, and informational design, writing, and editing of end-user documentation.

ing should be in boldface type in the manual and repeated several times.)

The documentation's explanation of what a spill file is and how it works is inadequate. Moreover, it gives no hint that you will have to deal with spill files at configuration before you get into the tutorial or the program. While it is easy to run configuration over again if you need to change your original answers, better documentation would eliminate this problem.

CREATING AND EDITING

You begin serious work with Deluxe at the main menu. The choices are displayed at the top of the screen. Underneath, the prompt reads YOUR CHOICE. Typing a single letter initiates file retrieval, editing, printing, and other functions.

The bottom line of the screen is used as a status line. When you are working on a document, the filename is shown at the left. On the right, Deluxe lists line, column, and page numbers—you always know where you are in a document. Program information, editing, and error messages also appear on the status line.

Before you can edit an existing document you must retrieve it. If you type D and then specify a drive, your files will be displayed. If you are in PC-DOS 2.0, you can specify both drive and path; for example, C:\Retrieval is accomplished by typing R at the prompt, and then your filename. You do not have to display files first.

I timed Deluxe's retrieval of a 4000-word document. It took 22 seconds to retrieve the document and its associated stored format and to bring up the editing screen. The original Volkswriter took only 15.1 seconds to retrieve the same file, but retrieving and entering edit mode are separate operations. (See table 1 for a summary of this and all the other timed tests.)

Starting a new document is easy: type C to create a new file, then enter a filename. Enter E to edit the contents and get down to work. Use E to return to the document you have been working on after any action that brings you to the main menu. When you retrieve a file, Deluxe automatically moves into the edit mode.

You can insert additional material into the existing text by pressing the Ins key on the PC's keyboard. The cursor changes from a blinking line to a larger block, and old text is added. In the normal mode, new text is typed over the existing text, making correction of simple typos easy.

Deleting text is quick and logical. You can erase by letter, word, line, or block. If you delete text it is gone forever: there are no safety messages to prevent you from accidentally eliminating text you want. I prefer word processors that temporarily save deleted text or at least check with you before destroying it.

Moving around a document for editing is also quick and easy. Pressing the Home, End, Page Up, or Page Down keys by themselves or with the Control key moves the cursor by letter, word, or line. A Ctrl-F9 will move you to a specified page. Scrolling from top to bottom of my 4000-word file took 30.1 seconds. (Volkswriter took 44.9 seconds.) The ease and freedom of movement is delightful.

SEARCH AND REPLACE

Deluxe's search and replace function can be global or selective. Once you have initiated a search, press F7 (Find key) to continue the process. You do not have to reenter your word each time. When Deluxe reaches the end of the file, it automatically wraps around to the top and continues searching the whole document. In my timed test, searching for the last word took just 7 seconds.

As with most word processors, the search function is both case-sensitive and dumb. It can only recognize the exact pattern of letters in your query, even when they are in the middle of another word. You may have to search twice to find all occurrences, and some of those you find may not be correct. However, this is a minor annoyance.

BLOCK MOVES

Identifying a block of text to move or copy involves marking the beginning and end of the block by using the F5 and F6 keys and moving the cursor to the spot where you want to insert the block. Press Alt-F5 to move the block, Alt-F6 to duplicate it, or Alt-F8 to delete it. Use F2 to store part of a document to a separate file. If you make a mistake and try to use too many block markers, Deluxe notifies you on the status line.

Column moves are identical, except you use Ctrl-F5 and Ctrl-F6 to mark the beginning and end, respectively, of the column.

One special block function—NotePad—bears notice. When you mark a block and then use Ctrl-F2, the text is appended to the end of the NotePad file. Text already in the file is preserved. The file can be retrieved, edited, and printed just like any other file. I've used it to store footnotes for a report and as a place to make notes about phone calls. I consider NotePad a strong plus.

Deluxe has a few problems with block and column functions. First, moves are slow. The longer your document, the slower the move, even if it is only two lines. Moving large blocks slows things down further. A 100-word block that took Volkswriter only 0.6 second to move required 4.7 seconds in Deluxe, approximately seven and a half times as long.

Table 1: *The benchmark results for Volkswriter Deluxe compared to the original version of Volkswriter and WordStar version 3.3. All times are in seconds.*

Function	Deluxe	Volkswriter	Wordstar 3.3
Load	22.0	15.1	9.9
Save	21.9	10.7	24.9
Scroll	30.1	44.9	41.2
Search	7.0	3.5	10.5

Second, when you move large blocks of text, unwanted text may be involved in the action. The program automatically reformats the text around the block. If a section does not end with a carriage return, the following paragraph will be included in the reformat, leaving you with a mess to untangle.

I found one interesting bug. I had retrieved a very short file (about 12 lines) from the disk. When I read it, I decided I didn't like what I had written and wanted to start over. Rather than returning to the main menu to create a new file, I attempted to use the block-delete ability to erase the whole file. It was a disaster. Instead of a gaining a blank screen, I was dumped back into DOS.

I've repeated this exercise with both PC DOS 1.1 and 2.0 with the same results. Although the problem does not affect deleting a block of text that is part of a longer file, the block-delete feature is one of the least satisfactory parts of the program.

TextMerge

TextMerge is one more feature that is right on target. I find it one of the easiest ways to do mass mailings and insert variable data into a standard text. It is considerably simpler to use than WordStar's MailMerge utility.

To use TextMerge you have to set up two files. The first is a standard text file containing your letter. The second contains the merge file of names and addresses. Many database-management programs, including dBASE II, will provide data in the format used by the merge file. At the beginning of the letter (called the base document in the users manual), you insert the embedded command ..FILE to tell Deluxe which variable name in the text file corresponds with which variable in the merge file. In use, TextMerge automatically reformats paragraphs to maintain proper spacing and margins.

You can print all or part of the merge list. The output is printed simultaneously on your printer and monitor screen so you can see what

(continued)

AT A GLANCE

Name
Volkswriter Deluxe, version 2.0

Manufacturer
Lifetree Software Inc.
411 Pacific St., Suite 315
Monterey, CA 93940
(408) 373-4718

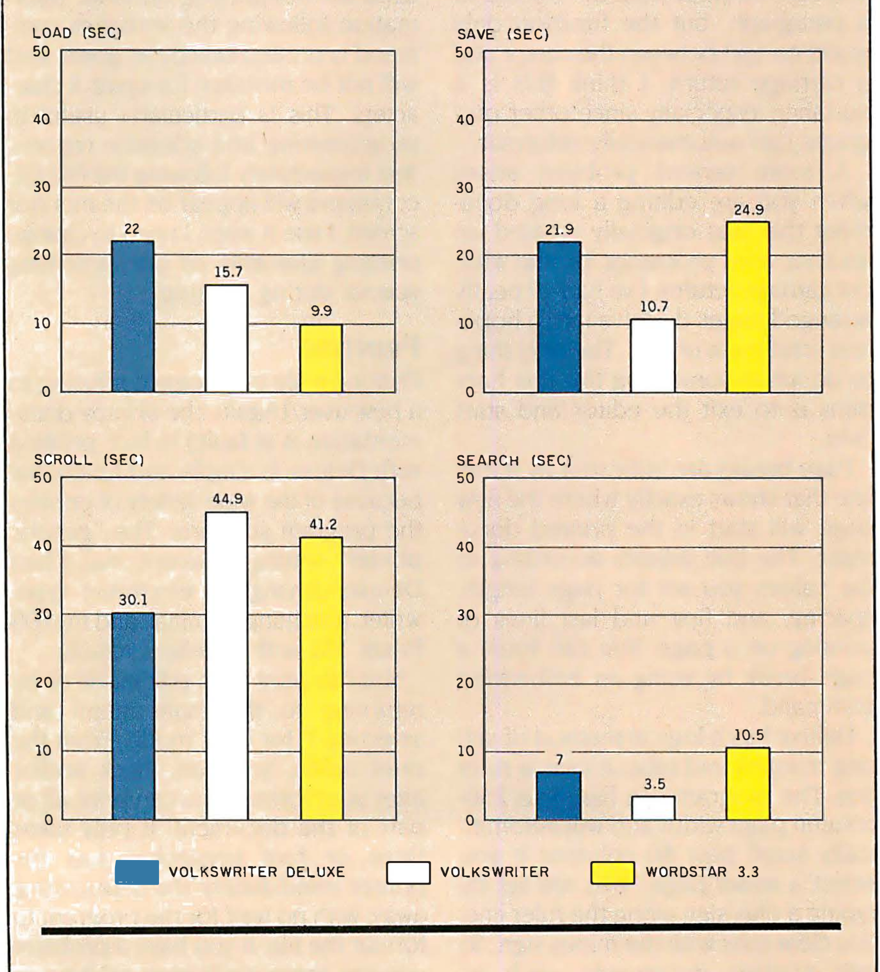
Format
5¼-inch floppy disk

Computer
IBM PC, IBM PC XT, and compatibles

System Requirements
PC-DOS 1.1, 2.0, or MS-DOS; 128K bytes of memory

Documentation
Three-ring binder, 150 pages, including on-line tutorial disk

Price
$295



These graphs show the timing results of performing various standard word-processing functions using a 4000-word text file. The times are for Volkswriter Deluxe, the original version of Volkswriter, and WordStar version 3.3.

is happening. One minor inconvenience with the TextMerge utility is that you cannot print just to the screen. You have to take the results on faith until you print out the finished letters.

The tutorial contains sample letter and merge files, as well as a file to create mailing labels. Load your printer with junk paper and play with the given files before trying to create your own.

Format and Page Layout

Deluxe belongs to the "what you see is what you get" family—you have to reformat each paragraph after editing. Reformatting requires moving to the start of a paragraph and pressing F8. You can reformat from the middle of a paragraph, but the function only works on text between the cursor and a carriage return. I think this is a nuisance, especially since other programs can automatically reformat.

A more serious problem arises when you are editing a long document that was originally created on another word processor, or one without carriage returns. I've had 19 neatly arranged pages dissolve into a hopeless solid mass of text. The only thing to do when something like this happens is to exit the editor and start over.

Page breaks are indicated by a thin line that shows exactly where the new page will start in the printed document. The line adjusts according to the values you set for page length, spacing, and first and last lines of printing on a page. You can force a page break by using an embedded command.

Deluxe has a logical method of setting margins and tabs: it uses a ruler line. The program can handle a 250-column page width and will automatically scroll past 80 columns if you select a wider page. Tabs are set by typing a plus sign along the ruler line. You clear tabs with the minus sign. To edit nontext documents, such as BASIC programs, you use an asterisk for the right margin. If you set multiple margins, Deluxe will recognize only the innermost pair.

You can create and save a format for a particular document or class of documents. Deluxe will automatically retrieve that format, rather than have you set the format each time. The format includes margins, tabs, printer type, page length, first and last lines of printing on a page, spacing, and right justification. The formatting options depend on which printer you selected during configuration.

Deluxe's short list of embedded commands covers the basics and then some. You can specify any number of headers and footers, as long as headers appear above the first line of printed text. Footers must be positioned below the last line of printed text. A ..COMMENT command is used for nonprinting remarks. Information following the verbatim command is printed exactly as given and will not be mistaken for control characters. This is particularly useful in programming and scientific reports. Text immediately following the PAUSE command will appear on the monitor screen. I use it when I need to change printing elements or do something special during printing.

Printing

Printing a file may seem confusing to a new user. (Again, the skimpy documentation is at fault.) In fact, printing with Deluxe is simple and functional because of the wide variety of printers the program supports. The "generic printer" setting is exceptional. I had Deluxe driving an electronic typewriter, a printing terminal, and my IDS Prism 132 with excellent results.

You can print from edit mode or by returning to the main menu and selecting P for print mode. From the print menu, you can check and/or alter your format. You can print all or part of the document. It only takes three or four keystrokes and the printer immediately starts pounding away, with no wait for the program to format the file. If you have a problem you can temporarily stop printing or quit.

If your printer is not amenable to printing a circumflex, grave accent, or umlaut, Chapter 7 in the users manual will give you an overview of how to use Deluxe for multilingual and scientific applications. Appendix F shows how to make keyboard and printer translation tables. If you need these capabilities but are a novice, don't struggle to create the translation tables on your own. Get help from your dealer or a knowledgeable friend.

Saving Documents

Saving a document couldn't be simpler. You have two choices. Return to the main menu and select S. Deluxe will respond by listing the original filename used to retrieve the document and will ask if you want to use the same name. If you say no, you can enter a new name for the file. Or, if you have set up the program to perform automatic backups, the original file will be renamed with the extension .BAK and your newly edited file will be saved under the filename. Saving is considerably faster than retrieving; Deluxe took 21.9 seconds to write to disk. Volkswriter again was faster at 10.7 seconds.

With some word processors, saving a file to a full disk can result in disaster—a total loss of data. This shouldn't happen with Deluxe. If the file you are trying to save will not fit on the disk, the program sends you a message to use another disk. You are safe as long as you have another formatted disk available.

Documentation

I have already made some negative comments about the documentation. Granted, the user's manual is adequate. However, although explanations are clear, they tend to be very brief. In some cases they are close to being cryptic, particularly the discussions of format selection and printer and keyboard customization. I would like to see more step-by-step explanations of the various functions. Examples, especially for using embedded commands, would also be welcome.

The on-line Help facility is also terse. Typing H at the main menu brings up a one-sentence explanation of the main menu options. In edit mode, you

can use F1 to toggle the function-key Help menu on and off as needed. Either Help screen can serve as a memory refresher, but neither is useful for rescuing you from a total panic situation. You will need to refer to the manual for fuller explanations.

The documentation does have a few saving graces. The user's manual index is good compared to most documentation. The table of contents is almost detailed enough to replace the index for many questions. And the troubleshooting appendix seems to answer many standard problems.

I suspect Lifetree Software is depending on the tutorial disk included in the package to replace the printed documentation. Good as the interactive tutorial is, it can't help you when you have questions while you're using Deluxe. I like the tone of the tutorial; it is friendly but not overly familiar or condescending. Computer novices will be able to understand the tutorial, but more experienced users will whiz through it.

Deluxe is polite about keeping you informed. First, the program gives you a long list of messages that appears on the status line as the program is carrying out some action. In addition to these working messages, Deluxe contains an error-trapping routine. Rather than having you rely on aggravating DOS (disk operating system) taunts when the program encounters a system error, Deluxe will suggest what needs to be corrected.

PLUSES

Deluxe has several outstanding features. I haven't found any full-function word processors that are easier to learn and/or use. The tutorial disk can be rated very good to excellent, depending on your prior knowledge of word processing and computers.

I award points for the on-line Help screens. Although Deluxe's Help screens are exceedingly brief, I prefer them to paging through multiple Help levels or doing without.

NotePad is an excellent concept, well carried out. I wish I had it on my database-management program.

I'd also rate TextMerge as very good to excellent. This function makes Deluxe a reasonable choice for a business that requires many short standard letters.

MINUSES

Although my criticism of Deluxe's documentation and reformatting capabilities can be classified as personal prejudices, I do see a few flaws in the program.

The use of spill files adds to Deluxe's flexibility, but they are potentially dangerous. Remember that you risk losing everything if you remove the disk with the spill file during a work session. (Better documentation would minimize the problem.)

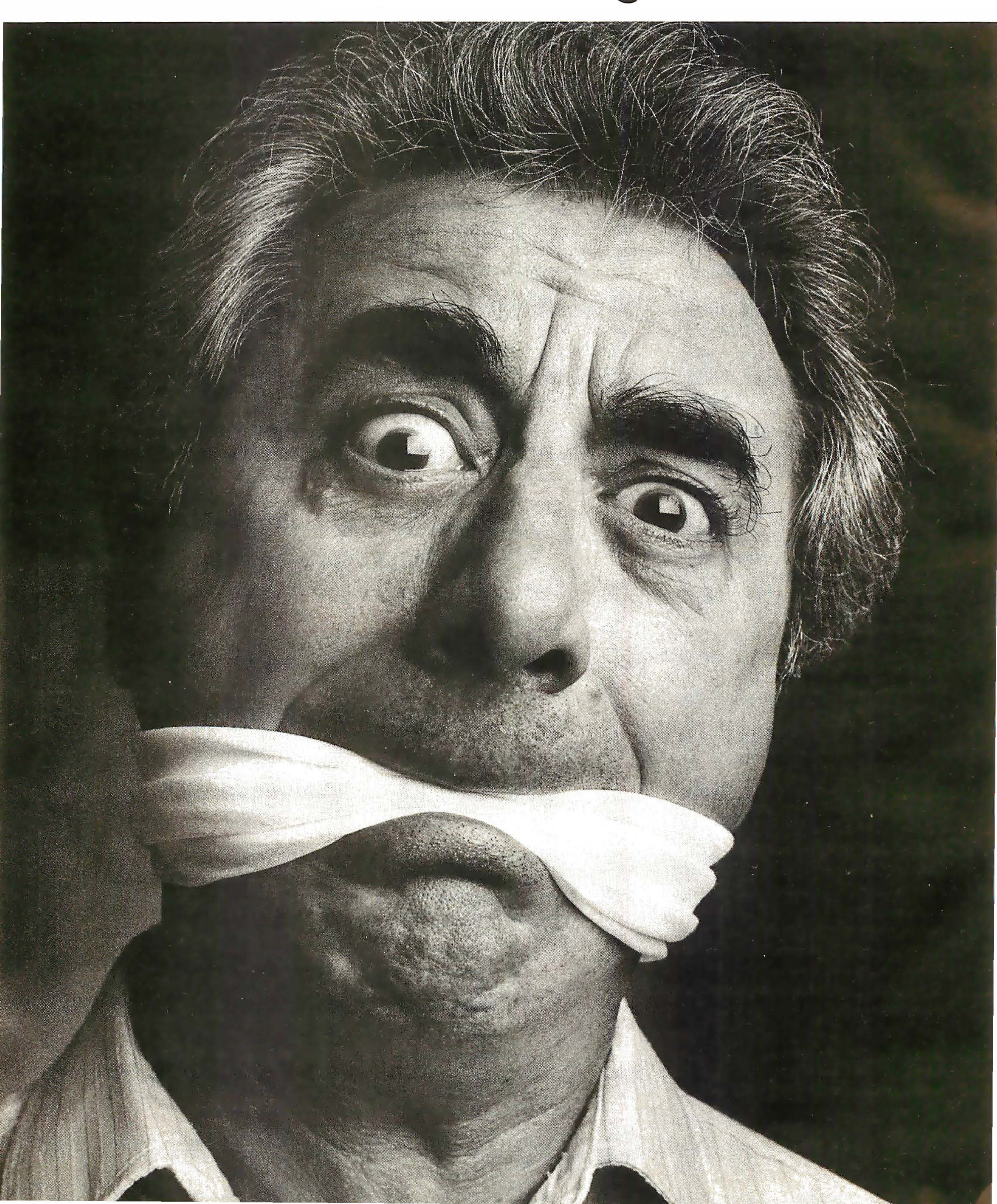
Deluxe's documentation is minimally adequate. I think Lifetree is doing its product a disservice. Good as Deluxe is, it would profit from upgraded documentation.

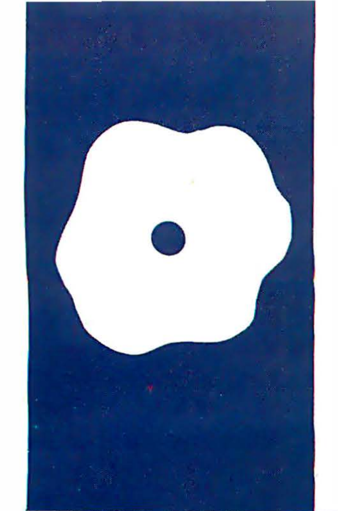
Block manipulation is poorly implemented because it is so slow. However, marking the block to copy, move, or delete is easier than in some programs I have used. Paragraph reformatting is a minor nuisance.

CONCLUSIONS

On the whole, I'm impressed with Deluxe. I particularly like the logical use of function keys and the program's ease of use. I have seldom found a word-processing program that serves every need of a serious writer and is still easy to use. In the few weeks I've had the program in my office everyone there has shifted from their word-processing programs to Volkswriter Deluxe. I've even come to depend on it for my short letters and the many tables of figures I need for reports. Contrary to my own rule to never buy software I review, I am buying Volkswriter Deluxe. It stacks up as a definite winner. ■

To communicate voice the ordinary modem





S·O·F·T·W·A·R·E R·E·V·I·E·W

HomeWord and Cut & Paste

Two easy-to-use word processors for the Apple II series

BY KEITH CARLSON

Word processors designed for home use should be cheaper and simpler to use than those intended for the office. In the relatively simple, short writing jobs normally done at home (such as personal correspondence), home word processors should replace pens and typewriters. Two new word processors that meet these needs, Sierra On-Line's HomeWord and Electronic Arts' Cut & Paste, run on the Apple II series as well as other popular computers.

Most home users won't spend a long time learning to use a word processor. Both programs I reviewed eliminate the more esoteric features of a professional word processor, and both have carefully designed user interfaces that cut learning time to a minimum. Documentation for both programs is short and easy to read.

As a group, home users own and use a broad range of peripherals, less standardized than their office counterparts. A home word processor should be able to accommodate a wide variety of printers and interfaces without bothering the user with technical details of the actual interface. To accomplish this, the program must be sophisticated, but its complexity must be hidden from the user.

HOMEWORD

HomeWord's user interface is primarily visual; the program uses icons in place of an on-screen menu and visual clues at the bottom of the screen to display free buffer memory and disk space. Instead of requiring an expensive 80-column card, HomeWord displays text in a 40-column format and provides a sketch or map at the bottom of the screen to represent the finished page (see photo 1). As you add text to the screen, it is represented on the sketch with its final format, including margins, line spacing, and cursor position.

HomeWord supports a full range of entry options: you can center, align (left, right, or both), indent, or tab text easily from the icon menu. When you exhaust memory space (indicated by the scales at the bottom of the screen), you can only save and load files—you lose the other entry options. HomeWord controls cursor movement using either the arrow keys or control-key combinations. You have your choice of scrolling in either direction by increments of character, word, line, screen, or true formatted page.

When deleting, replacing, and moving text using the "edit" menu choice, you first tell the program where you want to start the change, then you mark or "paint" the area that will be affected. You can scroll either forward or backward from the anchor spot that you have marked, highlighting as you go, in a fashion similar to the dedicated word-processor feature. Any deleting errors can be quickly fixed if you have chosen the delete mode from the icon menu; a delete buffer holds the last deletion in case you need it back. Changes made with control keys are not stored in the delete buffer.

For the sake of simplicity, many high-powered functions are not included in HomeWord. These include features like reverse find or find and replace, multifile operations, columnar editing, and macros (single keystroke entries that can replace strings of frequently repeated commands). The average home user will probably not need these functions.

COMMAND STRUCTURE

HomeWord's command structure, as represented by the icon menus, is simple and intelligible. The main menu can be reached at any time from the screen simply by pushing the Escape key. The icons are not mysterious symbols; each appears with its function listed beneath it, which helps eliminate confusion (see photo 2).

HomeWord's icons work because of the simplicity of the command structure and the small number of functions. Icon menus probably would not work with a complex

(continued)

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word processor like WordStar. The number of different icons needed to represent WordStar's dozens of functions certainly would be confusing, and duplicate icons undoubtedly would be needed. Most of HomeWord's icons are unique; that is, very few symbols have one meaning in one submenu and another meaning somewhere else in the command structure. This minimizes mode-related errors.

Icons in the main menu call submenus made up of other icons. Some commands require that you make your way through four levels of choices. Each menu level appears on the screen with a commonly used function highlighted as a default value. For example, the main menu appears with the "file" option highlighted. The "file" submenu offers "save document" as the default. This means that a Save operation requires very few keystrokes, encouraging frequent saving. Assuming that many people using HomeWord will be new computer users, unaccustomed to careful computing habits, this seems like a clever piece of design work.

Some operations, however, are cumbersome using the icon menus. For example, turning the underline function on and off using the icons requires 16 keystrokes. Sierra On-Line has provided keyboard alternatives, with a quick-reference card, for people who prefer not to use the icons.

Homeword's user interface is primarily a visual one, using icons in place of an on-screen menu, and visual clues at the bottom of the screen to display free buffer memory and disk space.

CENTER NEXT LINE
This is a centered line.

UNDERLINE
This is an underlined line.

Homeword provides a sketch at the lower right-hand corner of the screen

Page: 1
Free mem:
Free disk:
Press ESC to go to the menu.

Photo 1: *HomeWord's text mode. The scales at the bottom left-hand corner display memory and disk space. At the right is a sketch of the document.*

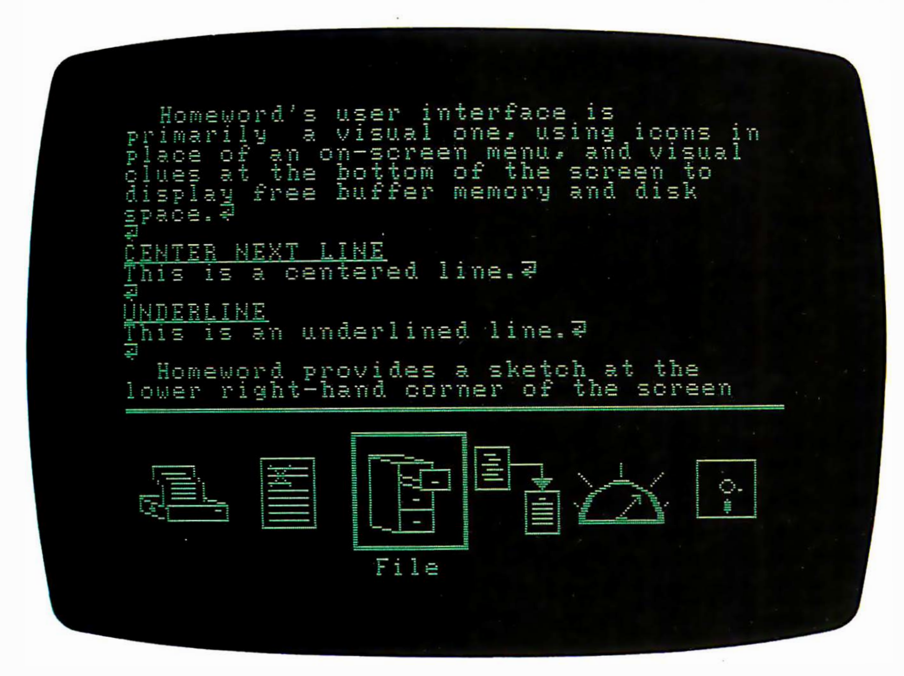


Photo 2: *HomeWord's main icon menu.*

Text Storage

HomeWord uses standard DOS (disk operating system) text files. When I dumped a file, I found that the text was in lowercase on the screen and displayed a variety of garbage. When I displayed the file with a program that translated everything to uppercase, I had better luck.

If you have at least 64K bytes of memory, you can configure your copy of HomeWord to work with two disk drives.

Backup Policy

The HomeWord disk is copy-protected, but you can get a backup copy when you send in your product registration card along with $10. I disagree with this policy—clever pirates will get copies anyway, while purchasers are forced to pay for the pirates' dishonesty. Perhaps Sierra On-Line should consider including an additional copy of the program with the purchase of HomeWord.

Printing

HomeWord works with a wide variety of printer interfaces. You can choose quickly and easily from among about a dozen drivers (short pieces of ma-

(continued)

AT A GLANCE

Name
HomeWord

Manufacturer
Sierra On-Line
POB 485
Coarsegold, CA 93614
(209) 683-6858

Type
Home word processor

Format
5¼-inch disk

Requirements
Apple II, II+, or IIe with at least 48K bytes of RAM and one disk drive; or Commodore 64 with one disk drive (soon to be available for Atari)

Price
$69.95

Documentation
33-page manual, quick-reference card

Name
Cut & Paste

Manufacturer
Electronic Arts
2755 Campus Dr.
San Mateo, CA 94403
(415) 571-7171

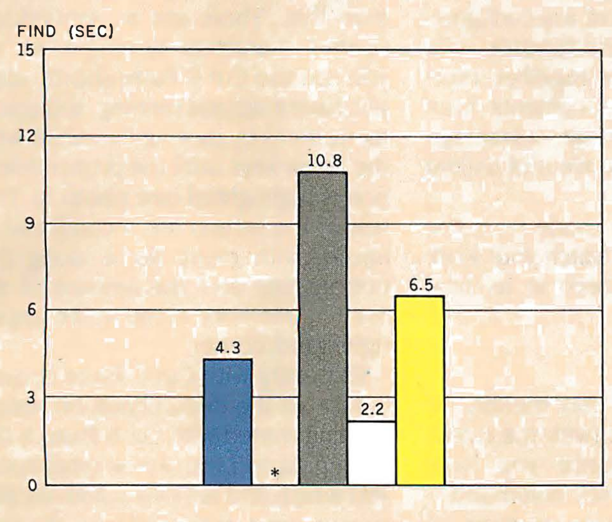
Type
Home word processor

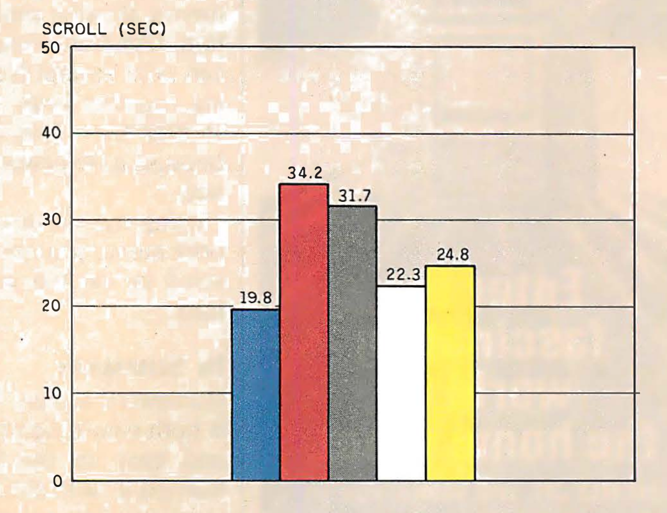
Format
5¼-inch disk

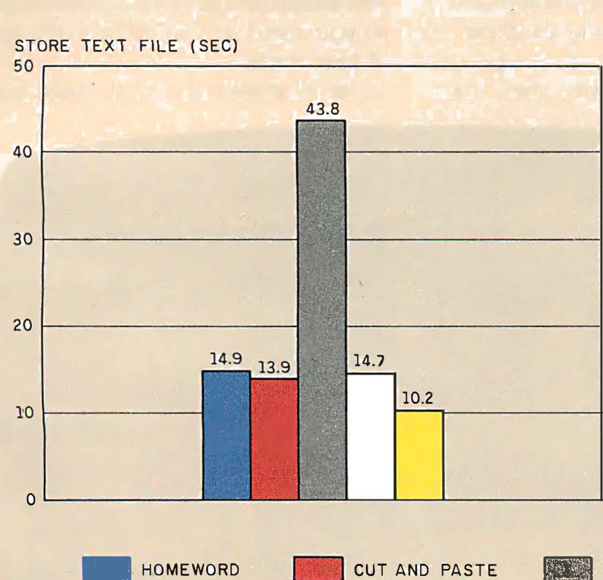
Requirements
Apple IIe with 64K bytes of RAM and one disk drive; Apple IIc with 64K bytes and one disk drive; Commodore 64 with one disk drive (soon to be available for IBM PC and Atari)

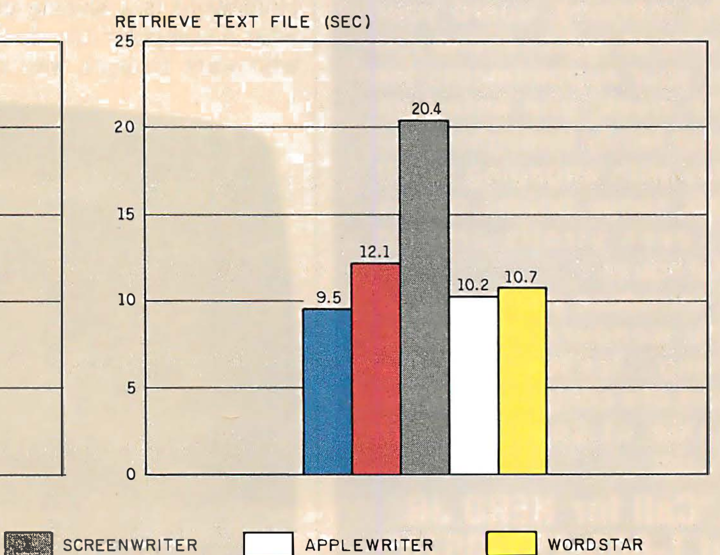
Price
$50

Documentation
14-page manual, quick-reference card





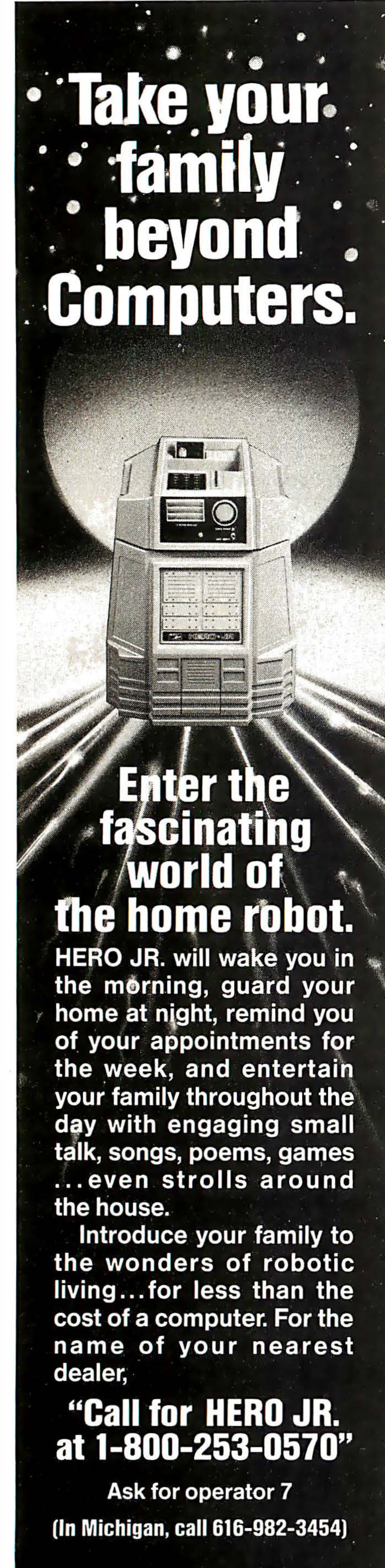




HOMEWORD CUT AND PASTE SCREENWRITER APPLEWRITER WORDSTAR

This is a comparison of HomeWord and Cut & Paste on the Apple IIe with ScreenWriter II, Apple Writer II, and WordStar (CP/M, using the Microsoft SoftCard). Because HomeWord could not accommodate large text files, a 9.5K-byte text file was used for testing rather than a 4000-word (or 24K-byte) text file, which is the usual standard. The Find (or Search) benchmark times how long it takes to find the last word in the document, starting at the beginning. The Scroll benchmark times how long it takes to scroll through the document. The Store and Retrieve benchmarks time how long it takes to save and retrieve the document from the disk.

*Cut & Paste does not have a Find function.



chine-language code that accommodate a particular printer). It is a joy to find a word-processing program that not only solves my Apple parallel-interface "high-bit blues," but also easily accommodates the excellent features of the Epson RX-80 printer.

Proportional spacing is accomplished with space insertion, and HomeWord's spacing looks about as good as space-insertion justification can. You can choose a wide variety of paper styles and widths from the icon menus, allowing almost any configuration. Using an Include function, you can print several files together, piecing together large documents from shorter files. This is an advantage because a HomeWord file is of limited size.

Using the preview mode from the print menu, you can watch your work scroll by on the screen in its final form.

IN SUMMARY

HomeWord is truly "user friendly." It is both easy to learn (with the icons) and easy to use once you have learned it (with the key commands). HomeWord is a shining example of what a computer can do for people who want to work with their computers without having to learn how their computers work.

CUT & PASTE

There are a lot of similarities between HomeWord and Cut & Paste. They are both designed with the home user in mind. Cut & Paste doesn't use icons, but its menu choices, in English text, are just as easy to use.

You choose all commands (except cursor-control commands) from two menus—you can't get much simpler than that. There are no embedded control characters to remember, so you can use Cut & Paste shortly after you have it up and running. You select menu items by moving the cursor with the arrow keys until the proper selection is highlighted (see photo 3). The rest of the screen has a comfortable layout, with menu items along the bottom line and the amount of remaining memory noted in the upper right-hand corner.

Text entry with Cut & Paste is easy. In fact, as the documentation states, "getting started with Cut & Paste is like getting started with a new typewriter." Text wraps and reforms automatically, so you aren't distracted from the task of text entry.

Like HomeWord, Cut & Paste uses

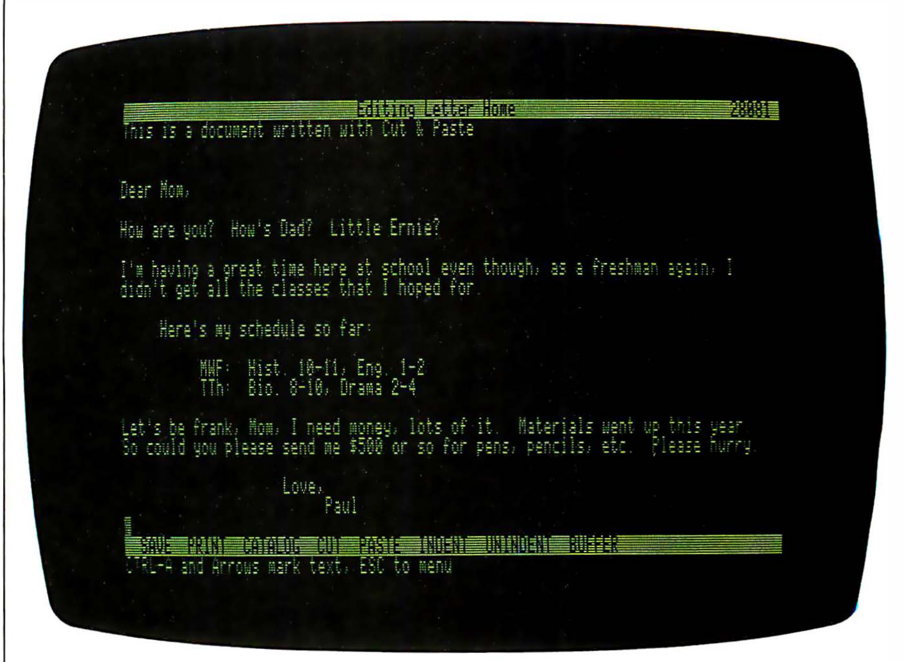


Photo 3: *Cut & Paste's functions are listed at the bottom of the screen.*

the "painting" technique to highlight text for moving or deleting. The delete buffer appears to be a bit larger than HomeWord's, and you can view the buffer in case you forget what you put into it.

Many of the functions we have come to expect in a word processor, such as centering, columnar entry, search and replace, boldface printing, and underlining, are missing in Cut & Paste. There is no indication on the screen of the true formatted page, unless you are equipped with 80-column hardware. If you aren't, you're out of luck. For the most part, though, touch-typists can enter text easily and quickly, as long as they expect only the features that they are used to on the typewriter. As in HomeWord, a lot of the advanced features of a word processor simply are not there.

Disk Problems

Cut & Paste seems to use its own disk-formatting scheme. This method makes normal Apple text files unusable in the Apple version of Cut & Paste. This is unfortunate if you have existing text files that you want to share with Cut & Paste. It also precludes passing files from other word processors.

If that isn't enough, the program disk is copy-locked. Although there is a 90-day warranty period within which a defective disk will be replaced free, Electronic Arts aggravated me by not even offering an inexpensive backup policy. If Electronic Arts would give two copies of the program or offer a low-cost backup policy it would be more in keeping with the company's emphatically stated "user-friendly" policy.

Printing

Electronic Arts emphasizes the ease of using Cut & Paste with its "Five-Step Rhythm of Printing." I agree with the claim that it is easy to use. All of the printing functions are chosen with fill-in-the-blank menus. Although there are no fancy or complex functions available, the output looks clean and crisp.

(continued)

BENCHMARKING HOMEWORD AND CUT & PASTE

Because the word-processing programs HomeWord and Cut & Paste are somewhat simpler than their more sophisticated cousins, I expected them to work faster than their counterparts. This was true with a few exceptions.

Each of the functions illustrated in the benchmark graphs on the "At a Glance" page was performed on the first part of the file used to prepare this review. It was approximately 9500 bytes long. I would have used a longer file, but HomeWord would not accommodate that. [*Editors Note: The usual document used for* BYTE *standard word-processing tests is a* 4000-*word (or* 20K-*byte) text file.*] The file was written with HomeWord and used as is with HomeWord and ScreenWriter II. Apple Writer II would not accommodate the formatting control characters used with HomeWord, so I edited out approximately 10 bytes for use with Apple Writer II.

WordStar is CP/M based, so I converted the normal Apple DOS (APDOS) text file created by HomeWord to CP/M format with the APDOS utility program supplied with the Microsoft CP/M master disk. It was the same size because it was not necessary to remove the formatting control characters.

Cut & Paste uses its own unique format, so I had to retype the file into Cut & Paste. Because Cut & Paste does not have a Find function, there is no entry for that section of the table.

I used the standard BYTE word-processing benchmarks with a 9.5K-byte text file (instead of a 20K-byte text file). The Find benchmark consisted of finding the last word of the document starting at the beginning of the document. In the scroll benchmark, I started at the beginning of the file and used the SCROLL command to go to the end of the file, one line at a time, as fast as possible. I used the Repeat key on the Apple keyboard to accomplish this. For the Store and Retrieve benchmarks, I saved and retrieved the text file on an Apple floppy-disk drive. In all cases, I measured the time that elapsed beginning from the last keystroke required to initiate the action until the cursor reappeared and I regained control of the program.

As a matter of human engineering, the margins, headers, and footers are measured in inches, rather than in lines and columns. This is an excellent feature. It removes all of the calculating and figuring when you are trying to get certain margins.

The documentation states that Cut & Paste has been tested with a variety of interface cards. For the Apple version, these are Apple Parallel, Apple Super Serial, Epson, Microtek Apple Dumpling, and Orange Micro Grappler/Grappler II+ to choose from. That covers a lot of the available popular interfaces. Cut & Paste has been tested for several printers: Apple Dot Matrix, C.Itoh 8510, Epson FX-80/MX-80, Star Gemini 10X, and the Okidata 90 series. Notably missing from the list is the whole group of daisy-wheel printers. Perhaps this is because they are in the minority for home use.

CONCLUSIONS

Cut & Paste's manual is short and written in plain English. There is a quick-reference card but no on-line documentation. To be fair, on-line documentation really isn't necessary because menu selections are obvious. Support is good; and Electronic Arts has just installed a new hotline for user inquiries.

Despite some obvious limitations, Cut & Paste is a good word-processing program. It is easy to use and learn. In fact, it shouldn't take longer than half an hour for a new user to learn to work with the program. Add to that its $50 price, and it's a good value. ■

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ROBERT L. GORMAN

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Circle 306 on inquiry card.

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ADDRESS ______________________________

CITY ______________ STATE ______________ ZIP ______________

Membership # ______________ (to be issued by desk clerk.)

PMN

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LOGITECH MODULA-2 includes a complete implementation of Wirth's design, plus 8086 large model support and additional LOGITECH modules (including display handling and dynamic string handling).

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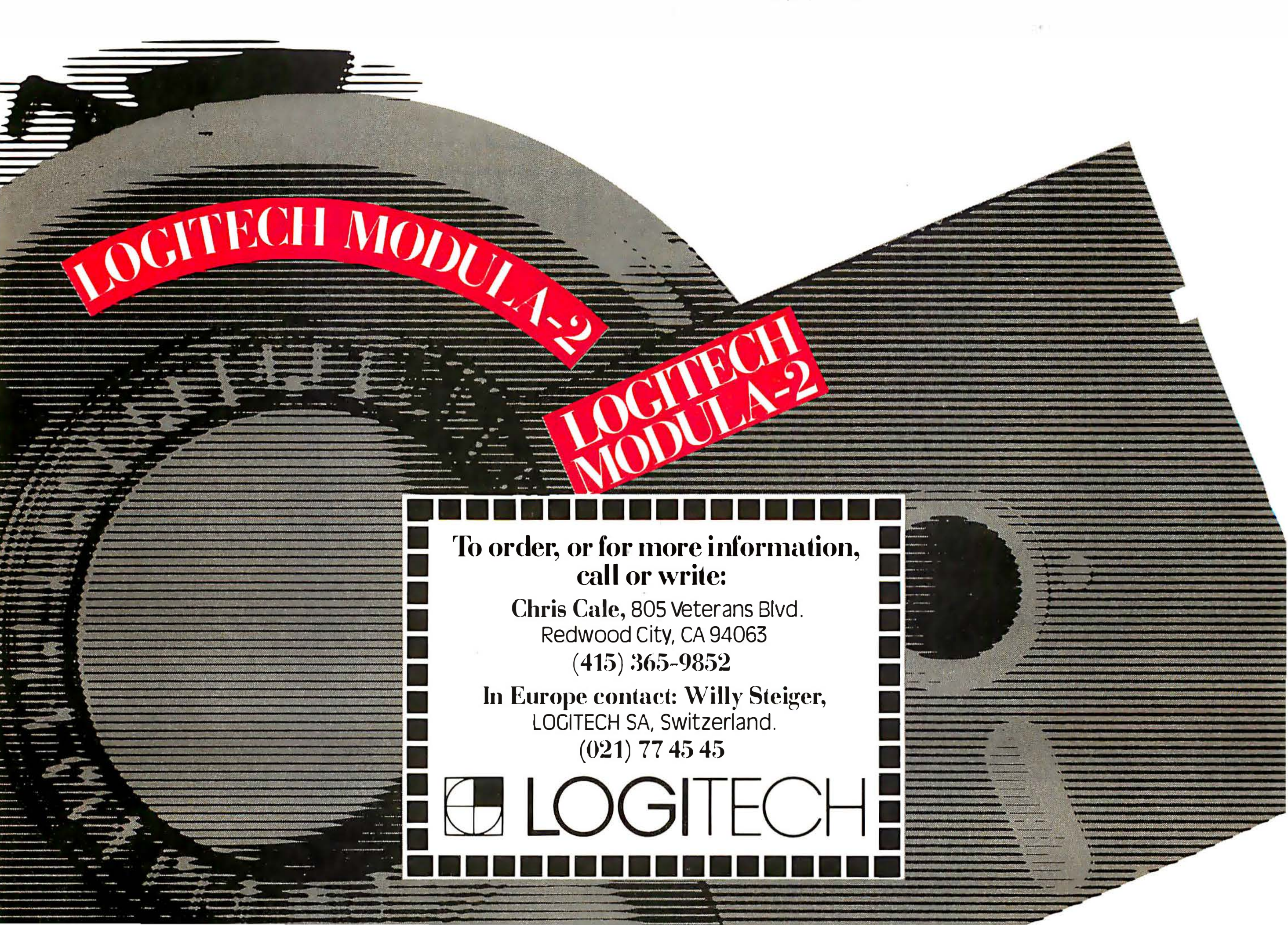
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S·O·F·T·W·A·R·E R·E·V·I·E·W

CLOUT and SALVO

A look at two natural-language query programs

BY GEORGE BOND

Entering data has never been much of a problem, even in the days when we were giddy with excitement at the prospect of cramming 48K bytes of memory into our microcomputers. Screen-entry forms and sometimes field attributes were used to make entry easier.

Getting data out was another story. Query structures that looked like crosses between LISP notation and the scribbles of a Boolean logician gone mad, or that used an endless series of menus, did their very best to discourage us from using the data.

During the past year, however, programs claiming to use natural-language queries for data retrieval have begun appearing on microcomputer dealers' shelves. Natural-language query consists of questions asked in normal syntax using a normal vocabulary. The computer should understand and respond appropriately. I believe that this type of query structure first appeared on microcomputers in Versafile, a late 1970s program that ran on the TRS-80 Model I.

For example, if I type into my computer, "What's on Main Street?" and the computer responds, "The American Guernsey Cattle Club," that's natural-language querying.

One natural-language query program is CLOUT from MicroRIM Inc., which is an add-on program designed to manipulate databases created by MicroRIM's R:base. The name is a pseudo-acronym standing for conversational language option (the meaning of the "UT" remains a mystery). It lives up to its billing as a natural-language query system, but is not without shortcomings.

CLOUT comes on three disks, including two versions of "Disk I" and a "Disk II" that are packed in the back of the familiar IBM look-alike three-ring loose-leaf binder. The manual (it is much too clearly written to be called documentation) runs about 170 pages and is divided into four parts: introduction, reference, tutorial, and index. It is typeset and is nicely printed and illustrated. The index is useful—it lists things in ways that make sense (e.g., "who" fields are listed under "Fields, Who"). There is also a four-page errata "Read Me" section that corrects some errors in the main manual.

The Basic Requirements

An R:base data file is necessary to run CLOUT. CLOUT is not a database creator, only an interrogator, so it does not generate its own content files. CLOUT requires PC-DOS or MS-DOS version 1.1 or higher running on an IBM Personal Computer (PC) or compatible computer with a minimum of 256K bytes of RAM (random-access read/write memory). A second version of the program, included as standard, requires a minimum of 384K bytes of RAM. It also requires two double-density, double-sided floppy-disk drives or one double-density, double-sided floppy-disk drive and a hard-disk drive.

First Impressions

When I first began using CLOUT, I was struck by the slowness of response—why did it take so long for anything to happen?

Of course, it really was not taking a long time for anything to happen. Lots was happening. It just was taking a long time for the computer to get the answer I wanted. The computer had to do heavy thinking about what I had asked. It had to convert "Who earned a pot of money last year?" to something like "List employee where totsal gt $100,000 and jobyr eq 1983." After doing the translation, the computer responded quickly. The snag is that most of us still think more quickly than a micro, at least in a situation like this. Maybe natural-language query isn't such a hot idea if you're in a rush.

My second feeling was a growing frustration with programs that insist on telling me that they don't understand what I want when they are supposed to talk my language. But, on reflection, this problem became clearer. Up here in the woods of New Hampshire, ask for a "milkshake" and

(continued)

George Bond is managing editor of User News for BYTE. He can be contacted at POB 372, Hancock, NH 03449.

AT A GLANCE

Name
CLOUT

Type
Natural-language query system

Manufacturer
MicroRIM Inc.
3380 146th Place SE
Bellevue, WA 98007
(206) 641-6619

Price
$195

Format
Three 5¼-inch floppy disks
(One "Disk I" requiring 256K bytes of RAM, one "Disk I" requiring 384K bytes of RAM, and one "Disk II." Both Disks I are copy-protected.)

Computers
IBM PC and compatibles

Documentation
IBM PC-style 170-page indexed manual

Audience
Anyone needing to make ad hoc inquiries of a database

Name
SALVO

Type
Application generator with natural-language query facility

Manufacturer
Software Automation Inc.
14333 Proton Road
Dallas, TX 75234-9990
(214) 392-2802

Price
$495

Format
Two 5¼-inch floppy disks

Computers
IBM PC and compatibles

Documentation
IBM PC-style 256-page manual, not indexed

Audience
Anyone needing an application generator

Photo 1: *The first thing to confront a user when booting* CLOUT *is the* R:*base logo and a request to enter a database name. Entering an escape cancels the program and returns to* DOS.

likely as not what you get is milk and flavoring whipped up. If you want ice cream with it, you must request a "frappe" (and that's not even an English word). Why should my computer be any more accommodating? This realization, however, has not done much to reduce the frustration felt when told by a machine, "The following expression was encountered . . . (the expression I typed appears here). Quite frankly, CLOUT is confused. Could you please retype your request?" Or "CLOUT has become confused while trying to understand your question . . . ." But it has made me aware that I must let the computer know that, to me at least, a "pot of money" means more than $100,000.

In many ways, CLOUT's spelling checker more than compensates for the slowness and "I'm confused" responses. If you are only a moderately good typist or are plagued with a mushy keyboard, this little gem can speed up operations immensely. Type in "What campanies are in Santa Clara?" and instead of getting an "I don't understand" or "There is no campanies field" response, you get "By 'campanies' did you mean 'companies'? (Y/N)". Until you have used a program with a good spelling checker in it, you simply cannot imagine what an asset you are missing.

Getting back to negatives, CLOUT cannot be fully hard-disk based: a copy-protected floppy must be in the system at boot time. This unnecessary busywork slows everything down—time is wasted swapping disks and load times are longer from a floppy than from a hard disk (it takes about 35 seconds for CLOUT to load when using a Columbia MPC 16-1 with standard Tandon drives). An even more serious problem would arise if the copy-protected floppy disk were to become damaged. You could not use your database until it was replaced. I find it hard to imagine being comfortable with computerized business records that are critical to daily operations without true defense-in-depth against the ravages of Murphy's Law. One of the abolutely basic defenses-

in-depth is having the capability of making a new backup as soon as an existing backup gets put into regular service.

Using Your CLOUT

CLOUT can be started in either of two ways. Disk II (which is copyable) can be put in drive A, Disk I in drive B, and the command B:CLOUT used to load the program. Or Disk I can go in drive A and be given the command CLOUT. It will load part of the program, then ask that Disk II be swapped into the drive to complete the loading. In either case, an R:base database goes into the B drive when you are ready to get down to business.

As CLOUT loads, it first displays the full-screen R:base logo and asks for the name of the database you want to use (see photo 1). When you enter this and the data is loaded, the main CLOUT menu (see photo 2) will be displayed. If you have already taught your database your special vocabulary, you can move right into asking it questions; otherwise, you must first do some educational work. In this way, CLOUT is like a not-very-smart dog—you have to train it before it can do much that is useful. This is not to say that CLOUT is totally ignorant when it comes out of the box. It isn't. It knows more than 240 words, phrases, and abbreviations—ranging from easy ones like "list" and "show" to whizzers like "standard deviation" and "approximately"—in addition to almost two dozen symbols (see table 1 for examples). But using these words is not too different from using any other query language, for instance SQL, INQUIRE, or, for that matter, dBASE II. The fun, and the power, of being able to ask a database of geopolitical information "Who are the freedom fighters?" and getting useful data in reply is what sets natural-language query apart. However, to have that fun you must do some work first because we don't all agree on terms and a program cannot be totally prewritten.

Setting up your own vocabulary using CLOUT is straightforward, if picky. Beginning at the main menu, you select option 4, "Fine-tune the request process." This drops you into another menu (see photo 3), with two options of immediate interest when training a new database—option 1, "Update a dictionary with database synonyms" and option 6, "Set fields

(continued)



Photo 2: *The main* CLOUT *menu offers six choices, including going back to* DOS. *Option 2, "Examine the schema...," is handy for checking database field names when creating new query definitions.*



Photo 3: *The "fine-tuning" menu gives access to modules that allow customization of* CLOUT.



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Table 1: *As delivered, CLOUT has a vocabulary of more than 250 words, phrases, arithmetical and comparison operators. Some examples of each are shown.*

Vocabulary Word	CLOUT Definition
and	Use to select data. Signals continuation of the previous question if used as the first word. Also use to connect list items and conditions.
and or	Data will be selected if either or both of the conditions are satisfied.
and/or	Signals continuation of the previous question if used as the first word.
any anybody anyone anything	Indicates a possible yes/no question. Will also select data. Did any salesman travel to Brussels
approximately	Synonymous with about. Enhances the "fuzziness" of a number. approximately 22,000 (finds numbers that would round to or truncate to 22,000 within the number of significant digits, i.e., 21,500 to 22,999)
apr april	April.
are	Indicates a possible yes/no question. May use as a verb.
ascending	Qualifies the order in which sorts or group computations are performed. show the cumsales in ascending order

Arithmetic Operator	CLOUT Meaning
* x multiplied by	Multiplication.
+ plus	Addition.
sum summation total	The sum of the computed value. CLOUT calculates the answer. Use in comparisons, as a sort field, or computations by group.
– minus	Subtraction.
/ divided by	Division.
average ave avg	Use to compute an average.
standard deviation std	Use to compute the standard deviation.
< raise to	Exponentiation. Use to compute an exponential value. What is the value of 2<5? (this would return 32)

Comparison Operator	CLOUT Meaning
< less than or less than smaller than before below it under	Less than. Use to limit the data selected.
< = = < le at most or more	Less than or equal. Use to limit the data selected.
< > > < different from different than not equal ne not same as	Not equal. Use to limit the data selected.
= during eq equal equivalent same as	Equal. Use to limit the data selected.
> bigger than greater than gt more than or more than since after above	Greater than comparison operator: Use to limit the data selected.

to be labeled Who, Where, or When." Using the geopolitical example, if your database included fields named "organization" and "individual-member," you could use option 6 to tell CLOUT to print both when asked "Who." And with option 4, you would be able to define "group," "outfit," "company," "apparat," "cell," and "wing" as synonyms for "organization."

While none of this training is especially difficult, it is time-consuming. Establishing a truly useful vocabulary means that you must know your data well and must do some careful thinking about how you will be referring to that data. And because CLOUT allows writing generalized macros ("concept definitions" they are called), careful planning can save many lines of code.

SALVO—Inquire More Carefully

Another program, SALVO (Software Automation Language Vocabulary) from Software Automation Inc., is

(continued)

basically an application generator, but it uses a restricted natural-language query system.

SALVO is a very different sort of product from CLOUT. It is called "first and foremost an information manager" by its maker and is intended to help nonprogrammers write programs. It is described as being also an application generator and using a "new type of 'expert system'" to help users. The expert system in SALVO allows natural-language queries.

The program runs under PC-DOS, MS-DOS, CP/M-80, or CP/M-86 and requires a minimum of 64K bytes of RAM and two double-sided, double-density floppy-disk drives or one floppy drive and one hard-disk drive. It is supplied on two floppy disks. The program disk is copy-protected and allows only two backups to be made. The second disk is a data disk, and it must be used—it contains seed programs required by SALVO. When you require a new data disk, you copy the old disk and erase redundant files to make room for new files. You may copy the data file to a hard disk, but you must have the program disk in drive A when you start SALVO or the program will not run.

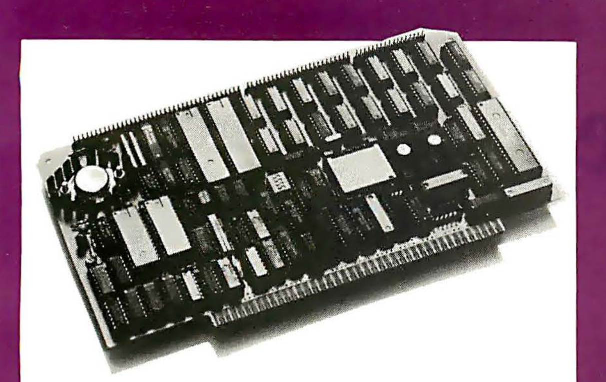
The disks are packaged with the manual in a slightly slimmer version of the IBM PC documentation binder. The 256-page manual is well written, typeset, and nicely illustrated, but is hamstrung by the lack of an index. Although it is filled with excellent information, including some clear explanations of relational data structures, the information is difficult to get at without an index. The manual is divided into four sections—an introduction, a functional guide, a case study, and a language summary.

Nonprogrammers, even first-time computer users, can certainly use SALVO. In fact, it probably would have its greatest appeal to electronics neophytes. SALVO will guide you, step by step, through the process of creating a computer program that can do useful work. Your first program on SALVO could be quite complex, complete with related files calling each other

(continued)

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***Lightning One is a trademark of Lomas Data Products, Inc.
****PC-DOS is a tradmark of IBM

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for reports.

As noted, the application generator works and can generate sophisticated programs, which is an important quality.

Language Barriers

The "Expert Command Assistant," the module for natural-language query, leaves a great deal to be desired. Its glossary of recognized words cannot be expanded in the same way as CLOUT's, and it is discouragingly short:

List, print, get, display, show, add, alter, change, delete, enter, modify, remove, update, by, for, in, of, on, and, or.

Its list of forbidden words is discouragingly long:

Are, how, is, was, were, what, when, where, who, whose, why.

Given such a restricted vocabulary, it is difficult to ask for data from files in natural language. "List salesmen who earned more than $5000," or "What salesman made more than $5000?" draws a response of "Request too complex. Please re-enter your request" from SALVO. The "who" and "what" words apparently are the source of the complexity for SALVO, since they are on the forbidden list.

The vocabulary can be expanded, but only in specific programs. If a query is okay except for an unrecognized word, SALVO allows you to shift to a display of the underlying code (see photos 4 and 5). You can then write your new definition into this code and save it either as a temporary file or a new, named file. If you save it as a named file, it can be run later like any other program.

Conclusion

There is an important point to keep in mind about any natural-language query system. It may be fun, it may be powerful, but because of the front-end time involved, it may not be the best tool to solve your problem. The time required to design and implement a proper vocabulary often can be justified only if the data is used

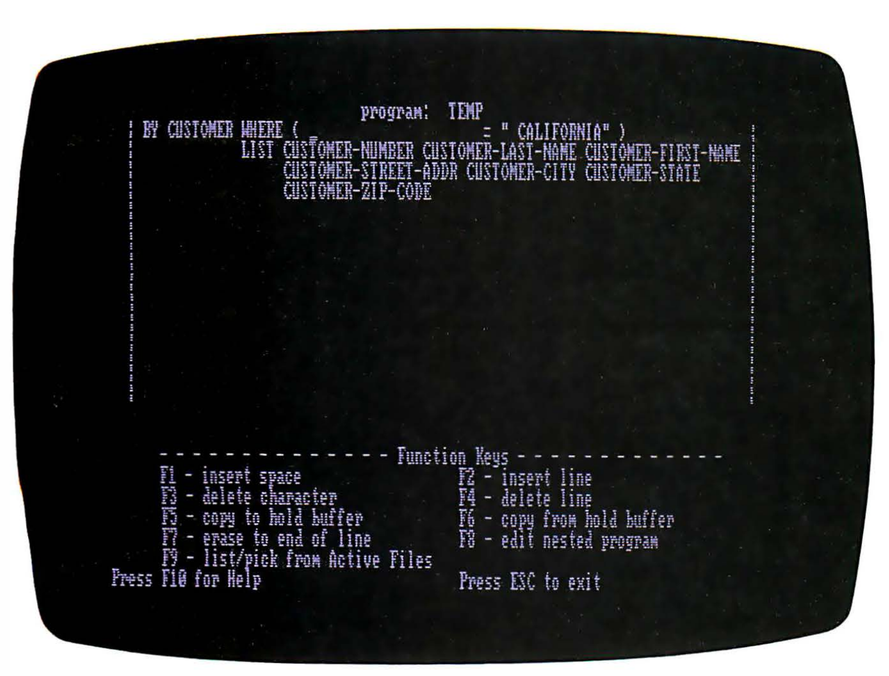


Photo 4: *When SALVO finds a word it doesn't know in an otherwise acceptable query, it allows dropping into source code and entering the needed information.*

```
                        program: TEMP
BY CUSTOMER WHERE ( customer-state_     = " CALIFORNIA" )
          LIST CUSTOMER-NUMBER CUSTOMER-LAST-NAME CUSTOMER-FIRST-NAME
               CUSTOMER-STREET-ADDR CUSTOMER-CITY CUSTOMER-STATE
               CUSTOMER-ZIP-CODE

--------------- Function Keys ---------------
F1 - insert space                 F2 - insert line
F3 - delete character             F4 - delete line
F5 - copy to hold buffer          F6 - copy from hold buffer
F7 - erase to end of line         F8 - edit nested program
F9 - list/pick from Active Files
Press F10 for Help                Press ESC to exit
```

Photo 5: *The user then has the choice of making this change a one-time event or saving it as a new program.*

regularly or if lots of people who know little about the structure of the database are going to be using it. Data that is needed only occasionally often can be better dealt with using other systems—a menu-driven query-by-example program, for example. And if an expert user—a "power-user" in the current jargon—will be the sole inquisitor of a database, perhaps the raw programming language may be the fastest way to get answers. ■


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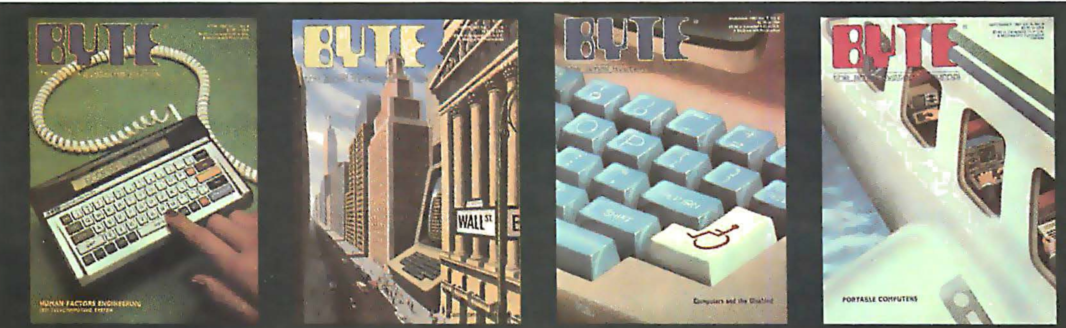
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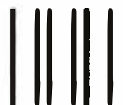
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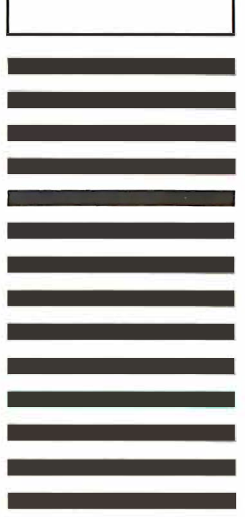
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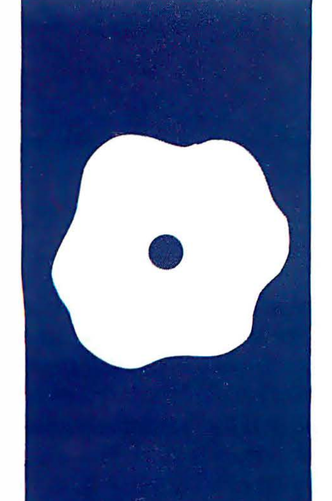
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DataEase vs. Condor and dBASE II

Comparison of a menu-driven program to two command-driven programs

BY BILL JACOBSON

Belittling the competition is a time-honored way of promoting computer programs. The popular dBASE II program from Ashton-Tate is the standard of excellence most often used to "prove" the alleged superiority of other software packages. For instance, a recent ad for DataEase, the subject of this review, boasts that it has "The power of dBASE without dBOTHER."

Some older programs still prosper, even though the competition from so-called state-of-the-art programs is intense. We shall examine how well DataEase, a relatively new program for the IBM PC, stacks up against two established database-management systems (DBMSs): Condor and dBASE II.

Test results are not conclusive. There are no winners or losers. These fine programs and others have their strengths and weaknesses. But the perfect DBMS program does not exist. Perhaps we must be content with database software that satisfies basic needs, yet has idiosyncrasies or deficiencies with which we can live.

THE THEORY OF RELATIVITY

DataEase, Condor, and dBASE are *relational* DBMSs. Their capabilities exceed those of comparatively simple one-file data managers like pfs:File or UltraFile, and they provide the means to handle complex, multiple-file applications. Separate files may be set up for customers, vendors, inventory, accounts receivable, accounts payable, and any other activities of a typical business-control system, with information intermixed among them. For example, data from the customer (name, address, telephone number, etc.) and parts files can be used in the preparation of customer invoices.

A "relation" is used to bridge the gap between where information is stored and where it is needed. A common field is used as a unique identifier to provide the necessary bridge. For example, the customer-number field may be used as a bridge between a customer file and an order file. The referencing file uses this identifier to match the appropriate record(s) in the referenced file.

Methods for handling data-file relationships vary among DBMSs. Condor relies exclusively on relational operators to accomplish this. One such operator is JOIN. The instruction JOIN CUSTOMERS ORDERS MATCHING CUSTNO will physically combine records in the Customers and Orders files, using customer number (CUSTNO) as a relational bridge. The resulting data file will contain all fields and information from both data sets and can be used to generate invoices, reports, and ad hoc inquiries that require data from both sources.

DataEase, dBASE, and some other DBMSs include other options as well. For example, information can be read interactively from a referenced data file, without having to combine two or more files physically. This Lookup function can be used to verify the accuracy of data keyed into a new record or to automatically obtain data from the referenced file (e.g., descriptive and price data from a parts file) after the appropriate part number is entered into an order form.

While a relational feature is essential for complex databases, it is only one of a variety of capabilities that a good DBMS should have. Others include processing speed, batch files to automatically process groups of commands, data quality assurance routines, data-entry standardization, etc.

Equipment used for this review includes an IBM Personal Computer (PC) with 512K bytes of RAM, two 360K-byte floppy-disk drives, a Davong 15-megabyte hard-disk drive, and monochrome and color monitors. PC-DOS 2.0 is the operating system of choice.

HOW THEY WORK

Table 1 compares some key DataEase, Condor, and dBASE II features. The PC-DOS ver-

(continued)

Bill Jacobson (5063 Coleridge Dr., Fairfax, VA 22032) is the owner of Compu-HELP. He holds a master's degree in public administration. His hobbies include sports, reading, classical music, and playing the piano.

Table 1: *A comparative overview of the features for the reviewed programs. Notes: (1) Requires programming; (2) Very limited capabilities, requires programming; (3) Program files may be located on more than one disk.*

Item	DataEase	Condor	dBASE II
Menu driven	Yes	No	No
Built-in programming language	No	No	Yes
Command/Batch file processing	Yes	Yes	Yes (1)
Custom screen generator	Yes	Yes	Yes
Password protection	Yes	No	No
Prevents duplicate entries	Yes	No	No
Data field masking	Yes	No	Yes (1)
Lookup file capabilities	Yes	No	Yes (1)
Maximum capacities			
Files open concurrently	No limit	1	2
Data-entry forms per file	No limit	1	1
Records per file	65,535	65,534	65,535
Fields per record	255	127	32
Characters per record	8000	1024	1000
Characters per field	255	127	254
Active index keys	255	1	7
Quick report generator	Yes	Yes	Yes
Complex report writer	Yes	Yes	No
Color capabilities	Yes	No	(2)
Uses IBM PC function keys	Yes	No	No
Program file disk space needed	590K (3)	270K	96K
Random-access memory required	192K	128K	128K
List price	$595	$650	$495
Available formats	Most 16-bit	Most	Most
Format tested	PC-DOS	PC-DOS	PC-DOS
Version tested	2.10	2.11	2.40

sions of each program are preinstalled. You simply prepare working copies of master disks included in the package (they are not copy-protected) and boot the program. Some other hardware and software configurations may require preliminary installation.

The following paragraphs summarize methods used with each DBMS to set up a typical application. Keep in mind that Condor and dBASE are 8-bit CP/M operating-system designs adapted to 16-bit machines. On the other hand, DataEase is designed to take advantage of the 16-bit environment of the IBM PC and similar computers, including the extended memory, function keys, and other capabilities of those machines.

The new dBASE III program was not available at the time of this review. Unlike its predecessor, it is designed for 16-bit computers and promises vastly improved capabilities and speed. dBASE III will initially be available only for the IBM PC.

DataEase

This is one of the new breed of relational DBMSs that are fairly simple to set up and use and that offer many powerful features. DataEase is totally menu driven. That is, all activities are selected from a series of preformatted or custom menus and submenus. Onscreen help is provided for many of DataEase's features, and current settings for function keys are shown at the bottom of the screen.

To initiate a database, enter a letter of the alphabet to identify it, your name, and a password. This sequence must be repeated each time you log on. Thus, up to 26 separate databases may be created, each of which may have an unlimited number of files—assuming you have an unlimited amount of disk space.

The DataEase password function provides three access levels: *high*, with no restrictions; *medium*, to view information, run reports, and enter or modify data; and *low*, to view information and run reports only. You may assign passwords to any number of people. DataEase does not provide foolproof protection for your information. All data is written to disk as ASCII (American Standard Code for Information Interchange) text files and can be read using the TYPE command of PC-DOS or transferred to a new file. Even so, this approach does regulate normal use of these files, and works very well.

After these preliminaries, the Main Menu appears (photo 1a). You may elect to customize the program to your liking and create data files, menus, and reports. The first stop is the System Administration menu, where you may "administer" password matters and three other options:

- Define Configuration: select the default disk drives, printer(s), and monitor type (color or monchrome); allocate system memory for sorting and other purposes
- Define Printers: modify existing printer drivers (15 are available) or create your own
- Define Screen Styles: modify color combinations, character blinking, and intensities

The next step is file creation. DataEase permits up to 255 fields per record and 255 characters per field. The combined length of all fields cannot exceed 8000 characters per record.

Data entry is accomplished with custom-designed forms (photo 2a), which are also used for record-by-record searches. Each form can contain one or more pages (there is no limit), with "page" defined as a computer screen of information. This is a useful feature if you want to decongest your screens by spreading fields over several pages. Once a form is named, a blank screen is displayed. To define the first and all subsequent fields, move the cursor to the desired spot on the screen and type in a field

description (e.g., First Name). This information may be located before, after, above, or below the data-entry area for the field.

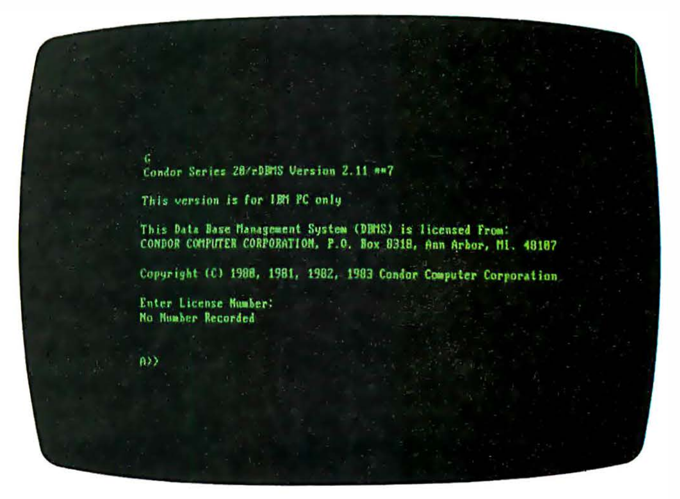
Move the cursor to the spot where the data-entry area will begin and press the F10 function key on the IBM. You must then make a series of decisions about field characteristics, a wide variety of which are possible, including three that are required—name, field type, and length—and six that are optional—indexed, unique, prevent data entry, range check, derived, and protected (photo 3). A comprehensive set of characteristics, like those for DataEase, helps to ensure the quality of data entered into your files. These field characteristics can help prevent errors by automatically entering the correct data, providing on-line verification of accuracy, or simplifying the keying of complex sets of data.

Field types can be text, numeric, numeric string, date, time, dollar, yes or no, and choice. Numeric strings are sets of numbers that have no mathematical significance (e.g., the sum of telephone numbers is meaningless) and may be divided by various types of separators. When data is keyed into a numeric-string field, any separators are automatically entered. This speeds entry and reduces the incidence of errors. Typical numeric strings are Social Security and telephone numbers: "999-99-9999" and "(999) 999-9999," respectively. If you are not satisfied with these preformatted options, custom data masks may be designed.

With the "choice" field type, as many as 99 optional entries of up to 60 characters each may be created. These options appear at the top of the screen during data entry or modification. Key in the number of your choice and it is automatically entered. For example, you might enter item 34

(continued)

Photo 1: *(a) DataEase standard main menu.*



(b) Initial Condor screen.

Photo 2: *(a) DataEase data-entry screen example.*



(b) Condor data-entry screen example.

of a field called Therapy Used to have the predefined message Dry Heat and Massage inserted. This technique not only speeds data entry, but also ensures that entries are of standard length and content.

When you want to create a derived field you have four options for the source of the field's information. They are: calculate (for calculated fields); lookup; sequence; and default. As indicated previously, the Lookup function may be used for the following purposes:

- entering information into a blank field on the form
- verifying the data in a form (that a part number keyed in manually actually exists)
- as a value in the calculation of a field

To implement the DataEase LOOKUP command, enter the name of the source file and field (e.g., LOOKUP Customer's Company). Then establish the correct relationship for this data, using item six on the Main Menu, "Menus and Relationships." You will receive an error message if the latter step is omitted.

The Sequence option permits sequential numbers to be entered automatically in a field. Check, invoice, customer, or other sequences of numbers are candidates for this feature. The next-higher number will always be entered.

An existing form may be modified at will. When the form to be modified appears on screen, make any corrections you want: delete fields, change their characteristics, add fields, etc. The revised version may be saved under another name or the original file overwritten. This function can be used to make duplicate copies of any form, with or without data.

The DataEase report feature is so powerful that you may initially be overwhelmed by it. Its features include:

- An optional data-entry form to provide user-supplied conditions—such as a range of ZIP codes—that specify what is to be printed in a report.
- Reports of any type. You may choose standard columnar or label-type formats or design your own report from scratch. Data also may be formatted as data-interchange format (DIF) or mail-merge files. Any standard

DataEase's report feature is so powerful that you may initially be overwhelmed by it.

format may be modified at will, using the report edit function. The edit screen does not scroll horizontally, making the design of reports wider than 80 columns rather cumbersome. A Report Print Style screen lets you customize other features for each report (photo 4).
- Ad hoc queries (e.g., a telephone operator retrieving the telephone number of a subscriber from his name and address) using the standard report-generation procedures—the so-called one-time-reports option on the "Reports and Questions" submenu. DataEase does not have the nonprocedural language capabilities of dBASE or Condor to obtain free-form responses and printed lists from your data files, without the bother of developing a report format. That type of feature is sorely missed and ought to be added to future releases.

Data from many files can be combined in a report, and the selection of fields and other display options may be totally manual, interactive, or some combination of both. The program diagnoses mistakes and whisks you to the location of an offending entry.

Custom menus and batch processing are accommodated through the "Menus and Relationships" option (photo 5). A menu screen may contain as many as nine instructions, and an unlimited number of menus and submenus may be created. Custom menus are then displayed each time DataEase is booted.

A variety of file commands may be batched (chained together) and executed automatically. These include predefined reports; various DataEase utilities, like file backup and restore; posting of updates to a master file; importing information from other

(continued)



Photo 3: *DataEase file creation: selection of field definitions.*

Circle 62 on inquiry card. For Dealer locations, see pg. 453.→

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databases; and program calls. The batch file commands of DataEase are good but not as extensive as those for Condor or dBASE.

Virtually any program can be run from within DataEase using the Program Call option. For instance, you may boot and use a word processor, another DBMS, or a graphics program and then return to the original DataEase menu. Programs to be "called" may be specified in a menu or entered by the user.

Photo 4: *DataEase print-style-selection screen for entering custom printer, page, and other settings for a report. These may be modified prior to printing the report.*

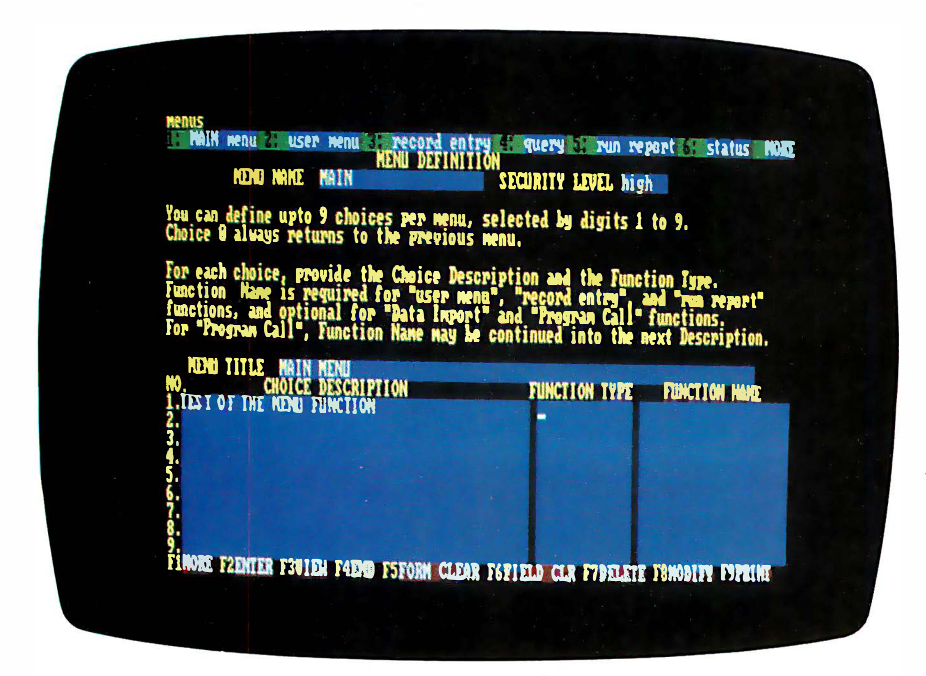


Photo 5: *DataEase custom menu-creation screen. Any number of menus may be created.*

CONDOR

In contrast to DataEase, application development with Condor is not menu driven and very little on-screen help is provided. After the program is booted, you are greeted with the system prompt "A>>" (photo 1b) if the default drive is A; then you must supply any subsequent instructions. On-line help is not available.

To create a file for your database, enter the command "DEFINE (filename)" and a blank data-entry screen will appear. This screen is used for all data-entry (photo 2b) and record-search activities. As with DataEase, data fields may be located anywhere on the screen. Position the cursor to the desired location, type and bracket the field name, and insert underscores—one for each character of the field—immediately after the field name. For example a 15-character field called "|FIRST NAME|" would require 15 underscores. Fields may be spread over two screens on 16-bit computers, and one screen on 8-bit models.

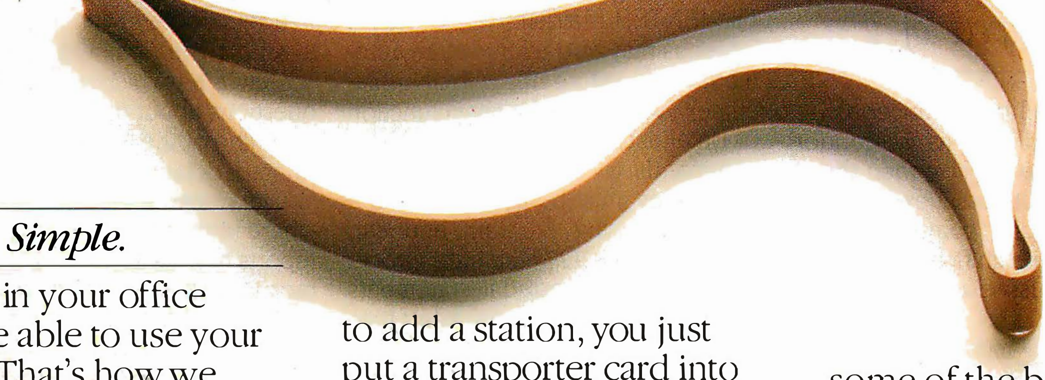
Each record in a file may contain up to 127 data-entry fields, the combined length of which cannot exceed 1024 characters. The maximum length of a field is 127 characters.

Once the field-creation process is complete, you must define the characteristics of each field on the data-entry screen. Options include alpha, alphanumeric, numeric, decimal, dollar, date, and required entry. Minimum, maximum, and default values may also be defined for a field. These choices are adequate for most purposes, but very limited when compared with DataEase. As explained previously, interactive use of information residing in other files is not possible, nor are numeric string masks like "(999) 999-9999."

Password protection is not available. A license number must be entered when the program is booted, but anyone who can boot the program

(continued)

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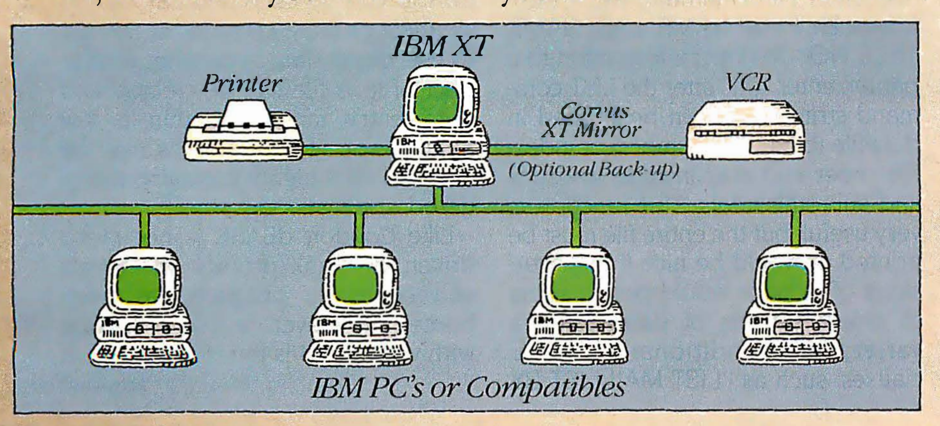
Dependable.

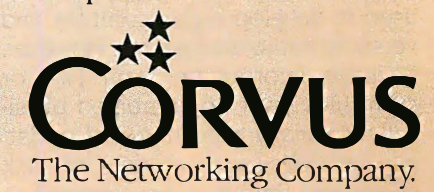
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dBASE II can be classified among the simplest or most complex of DBMSs to use, depending upon what you expect of it.

has access to all of its functions.

The command options of Condor are much more extensive than those of DataEase, but less flexible than dBASE. Forty-four commands are available; some significant ones are listed and discussed below:

ENTER creates new records.

UPDATE modifies existing records.

COMBINE merges two files.

COMPARE compares the data in two files and copies records that do not meet the prescribed conditions into a "Result" database.

CHANGE makes global changes to a file, using prescribed values.

INDEX indexes a database, using up to eight key fields. Only one index file may exist, which is automatically updated when a record is created or modified. If a database is sorted, it must be reindexed.

JOIN merges the record of two files that match specified conditions.

POST updates information from one file with that from another (e.g., a master parts file using daily sales information).

PROJECT creates a new file from preselected fields of another file.

SELECT extracts records from an existing file that match specified conditions.

REORG adds, deletes, or rearranges fields on a data-entry screen.

Sets of these commands can be used to develop highly complex and versatile database systems. However, because information from two or more files must be combined physically for many reporting and updating activities, a great deal of disk space and time may be required to process large databases with many processing steps.

Custom menus and submenus may be created with the HELP command, using procedures similar to those for DEFINE. One menu item per line may be entered, with the command string to be executed appearing below or beside it—e.g., "2. Add Record to The File [ENTER Maillist]."

Menus may also reference an automated procedure file ("RUN (filename)") which, like the chain function of DataEase, may contain a series of commands to be batch processed. These files must be prepared with a word-processing program and can contain up to 127 separate procedures, including nested IF statements and some non-Condor command files. The latter capability is of little value, as the memory requirements of non-Condor files cannot exceed 28K. By contrast, I was able to boot such programs as WordStar, Condor, dBASE, and R:base 4000 using the DataEase program call function.

An automated procedure file capability is particularly important with Condor. For example, many separate procedures may be required to prepare information for a report or to update and verify the accuracy of new or modified records. All of this bother can be reduced to the flick of a key with a well-designed procedure file.

Reports may be generated using the LIST, PRINT TITLE, and REPORT functions. The List and Print functions are identical. Reports generated by the LIST function may be output to the screen or printer and generated from a command file or from the system prompt line. Any ASCII text file can be listed. Typical syntax is LIST (filename) {field names}; e.g., "LIST Maillist BY FIRST.NAME, LAST.NAME TELE.NO." To direct information to a printer, enter "|P|" after the LIST command string. Lists can be printed in data-file (by record number) or index-file order and may include statistics and subtotals/totals. This function is very useful, but the entire file must be printed. It would be nice if later versions of Condor would permit users to select subsets of data, using a variety of conditional WHERE clauses, such as "LIST MAILLIST BY LAST.NAME CITY *WHERE* ZIP.CODE GE (is greater than or equal to) 22000."

The Condor REPORT function is quite versatile. Unlike data-file-related commands, REPORT is menu driven and has on-line assistance. The headers, footers, and data fields for a report are "painted" on a blank screen, after which you must answer questions about the characteristics of each line of the report (how it will be printed, default values, statistics, etc.). You may opt for a "short method," where fewer questions are asked and reports may be generated or modified more quickly.

Multiple-file reports cannot be generated interactively. Instead, information must be physically combined from the necessary files into a new one, using some of the commands listed previously. In addition, the new file must be sorted in the order needed; otherwise, records are printed in data-file order (in the sequence they were originally entered). REPORT does not have a built-in sort function like DataEase, and it is not possible to print in index order, an option available only with the LIST and PRINT commands.

Condor has one of the best data import/export (read/write) functions available. It is uncomplicated to use and will handle most types of text files transferred between different types of word-processor, spreadsheet, and database programs.

dBASE II

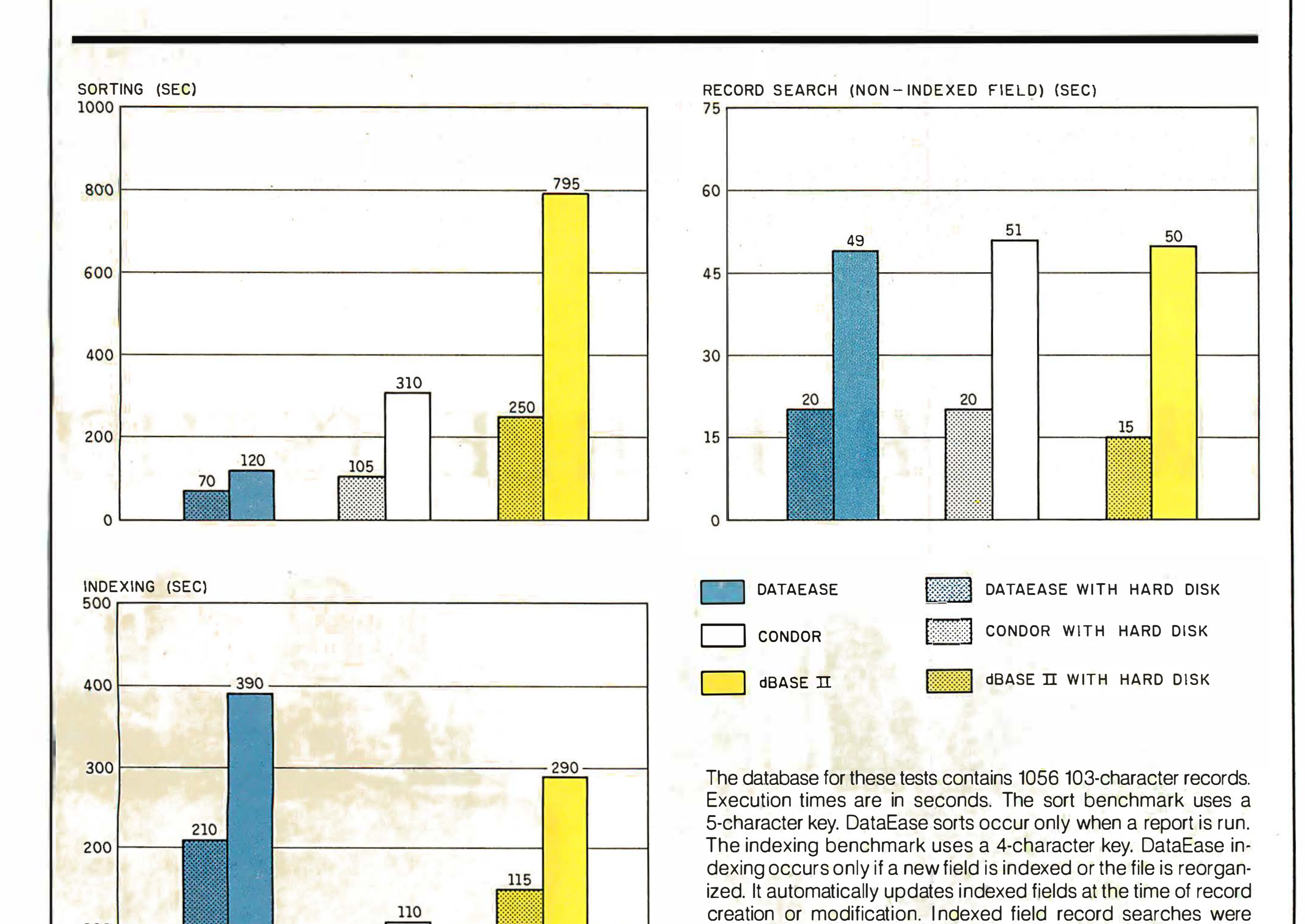
This program remains the standard that all newcomers are judged against. dBASE can be classified among the simplest or most complex of DBMSs to use, depending upon what you expect of it. A file can be created and data entry initiated within a few minutes, or several months may be devoted to a highly complex, many-tiered application.

Like Condor, dBASE is not menu driven. A blank prompt line greets you once the program has been booted. However, a useful feature with version 2.4 is the Help file. From

(continued)

AT A GLANCE

Name	DataEase	Condor 3	dBASE II
Type	Relational database-management program	Relational database-management program	Relational database-management program
Manufacturer	Software Solutions Inc. 305 Bic Dr. Milford, CT 06460 (800) 243-5123	Condor Computer Corp. 2051 S. State St. Ann Arbor, MI 48104 (313) 769-3988	Ashton-Tate 10150 West Jefferson Blvd. Culver City, CA 90230 (213) 204-5570
Format	5¼-inch floppy disk	5¼-inch floppy disk	5¼-inch floppy disk
Computer	IBM, Victor, DEC, TI, and other MS-DOS and CP/M-86 compatible computers	Most 8- and 16-bit machines	Most 8- and 16-bit machines
Documentation	301 pages, 5.5 by 8.5 inches, in a 3-ring binder	736 pages, 5.5 by 8.5 inches, in two 3-ring binders	291 pages, 8.5 by 11 inches, in a 3-ring binder
Price	$595	$650	$495



The database for these tests contains 1056 103-character records. Execution times are in seconds. The sort benchmark uses a 5-character key. DataEase sorts occur only when a report is run. The indexing benchmark uses a 4-character key. DataEase indexing occurs only if a new field is indexed or the file is reorganized. It automatically updates indexed fields at the time of record creation or modification. Indexed field record searches were essentially instantaneous for all the programs. However, Condor is limited to one active index key, and dBASE II supports seven active index keys, while DataEase may be indexed by all 255 fields.

Hard-disk drives afford larger storage capacity and are faster than their floppy-disk relatives.

the prompt line, enter "HELP (command name)". A brief description of the syntax needed to execute the command will then appear on the screen.

To start a new file, enter the command CREATE, the name of your new file, and the characteristics of each field in the file. Fields may be text strings, numeric, or logical (yes/no). Only 32 fields per record may be defined. Maximum record and field lengths are 1000 and 254 characters, respectively. After the last field is defined, you may immediately begin entering data. Password protection is not available. Data-entry masks and similar features are possible, but they must be programmed by the user into a dBASE command file.

A utility for preparing custom data-entry screens is included with dBASE. This utility is neither as easy to use nor as powerful as the various DataEase or Condor screen-oriented utilities, but it does help simplify the cumbersome dBASE screen-layout process. Within such a utility, you must program each screen using a series of special commands. Like everything else in dBASE, the difficulty of doing this is totally dependent upon the complexity of your application.

There is an incredible array of dBASE special commands, operators, and functions; it is a database-application generator with packaged routines *and* a built-in programming language. This capability makes dBASE much more flexible than either DataEase or Condor, which do not have programming-language interfaces. You may design just about any application you want using these features, but this effort may be very time-consuming and difficult. Some of the key dBASE commands are summarized below:

APPEND adds records to a file, from another dBASE application or an external ASCII text file.

BROWSE allows full screen viewing and editing of a file.

CHANGE allows global editing of selected records.

COPY copies file structure and/or records to another database or creates a mail-merge file.

FIND quickly locates records using the index key.

INDEX creates any number of index files. Only one index file may be active



at a time; indexes must be logged on to be used. Only the logged index is automatically updated when records are created or modified; other indexes may be updated using the REINDEX command.

LIST lists to screen or printer records of the file currently in use; unlike Condor, you may specify which records will be listed.

MODIFY COMMAND is a built-in command file text editor of limited capabilities. An external text editor or word processor may be substituted.

MODIFY STRUCTURE changes the structure of the database in use.

REPORT generates reports from the file in use. Report is easy to use but has limited capabilities. Existing reports cannot be modified. It is far less powerful than either the DataEase or Condor report generators. Complex dBASE reports must be written with the built-in programming language.

SELECT switches between the primary and secondary databases. Only two files can be open concurrently in dBASE, in contrast to the multifile capabilities of DataEase.

SORT creates a version of the data file in use that is sorted according to the specifications given in the command line.

STORE inserts data into as many as 64 memory variables. Sets of variables may be saved to disk and recalled as needed.

USE opens a database and closes the one in use. It also opens an index file if specified in the command line.

EXECUTION SPEED

As might be expected, hard-disk drives not only afford larger storage capacity but are faster than their floppy-disk relatives. A hard disk may be important, if not essential, for applications that have large data files and require a lot of disk-drive interaction (see graphs on the "At a Glance" page). Contemplate the difficulties of using and sorting a 10,000-record file that is divided into several floppy disks.

DataEase takes advantage of the 512K bytes of memory available in the IBM PC, which accounts in part for its superior sorting performance.

There are some "apples to oranges" comparisons in the benchmark graphs. DataEase does not have separate indexing and sorting operations. You may define as many as 255 index (key) fields in a DataEase file, all of which will be updated automatically each time a record is created or modified. In addition, it is necessary to sort reports only if nonindexed fields or two or more indexed fields are included in an "ORDER BY (sort)" specification.

(continued)

As expected, the statistics for Condor are very impressive. A Condor application may require numerous sorting or indexing actions.

The poor performance of dBASE on indexing and sorting tests is an anomaly when you consider the overall power of this program. Sorting of large files will require enormous amounts of time. Fortunately, utilities are available to overcome this and some other deficiencies of dBASE.

RATINGS

The comparative overall rating of the three programs is summarized in table 2.

Ease of Use. DataEase receives the highest overall mark. Its menu-dependent design and on-screen help both make development of a fully configured database much less time-consuming. In addition, it is simple to make any kind of modification to your files, and data-entry and record-editing routines are among the best I have used.

Curiously, a simple but usable file may be developed fastest with dBASE. Adding features to your bare-bones database, however, can be quite difficult; these add-ons usually require a significant amount of programming with the dBASE built-in language.

Condor is somewhere between these ease-of-use extremes. Simple databases can be implemented fairly quickly, but procedural file generation can be highly complex.

Error Detection and Correction. A DBMS or any other program should be able to spot technical problems (printer off, inadequate disk space, etc.), and resolve them without danger to your data files or abrupt exiting of the program. Each program was able to handle errors without data loss or file damage. However, I was abruptly exited from each program on occasion for sometimes unexplained reasons. With DataEase, for example, I deliberately switched some report-formatting commands (a common error) and then ran the report. The system did not freeze, but I was quickly thrown out of the program with the curious diagnostic "No Core." Ideally, I should have been told of my "mistake" when I attempted to leave the report-formatting function. Barring that, a run-time message should have alerted me to the error and perhaps spirited me back to the report-format function or menu.

Versatility. All three programs are versatile and should be capable of handling most business and other database activities easily. The dBASE II built-in programming language clearly gives it the overall edge in versatility, but again, at a price.

Documentation and Other Help. The DataEase manual is packaged in a

(continued)

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Table 2: *Qualitative evaluation of the reviewed programs. See text for details.*

Item	DataEase	Condor	dBASE II
Ease of use			
Simple database creation	Good	Good	V. Good
Complex database creation	V. Good	Fair	Poor
Data entry	Excellent	Good	Good
Simple report creation	Good	V. Good	V. Good
Complex report creation	Fair	Fair	Poor
Ad hoc queries	Fair	Good	Good
File layout modification	Excellent	Good	Poor to good
Error detection/correction	Good	Good	Good
Versatility	V. Good	V. Good	Excellent
Documentation	Good	Good	Good

tabbed and indexed loose-leaf binder. Detailed tables of contents appear at the beginnings of the manual and each chapter, and examples of actual screens are sprinkled liberally throughout. Page layouts are uncrowded and attractive. In short, Software Solutions uses the classic techniques of good manual design. For the most part, the DataEase manual achieves its goal of easing new users into a powerful computer program, but certain aspects of DataEase simply take time and experimentation to learn. A case in point is the excellent report-writer function, to which 114 carefully prepared pages are devoted. A fair amount of trial and error is required to become comfortable with it and even more to fully master it.

The Condor and dBASE programs are much more difficult to master, especially dBASE with its intricate programming language and command structure. The Condor and dBASE manuals are slick, professional, and beautifully packaged. Both have excellent quick-reference cards and lots of useful information packed into them. dBASE even offers a disk tutorial with version 2.4. I found that tutorial of marginal value, but a dBASE novice might react differently.

There are several by-products of dBASE's long-term popularity. User groups are available in some areas of the country, and several dBASE-related utility programs are marketed by several software companies. These utilities target some of the deficiencies of the parent program. For example, a sort utility called DBPlus greatly improves the mediocre performance of the indigenous dBASE sort function: sorting the test file on hard disk took 40 seconds with DBPlus, rather than 250 seconds. Application generation packages are also available to simplify file and data-entry screen preparation. None of these application utilities totally eliminates the hard work of creating a complete dBASE design, but they can help.

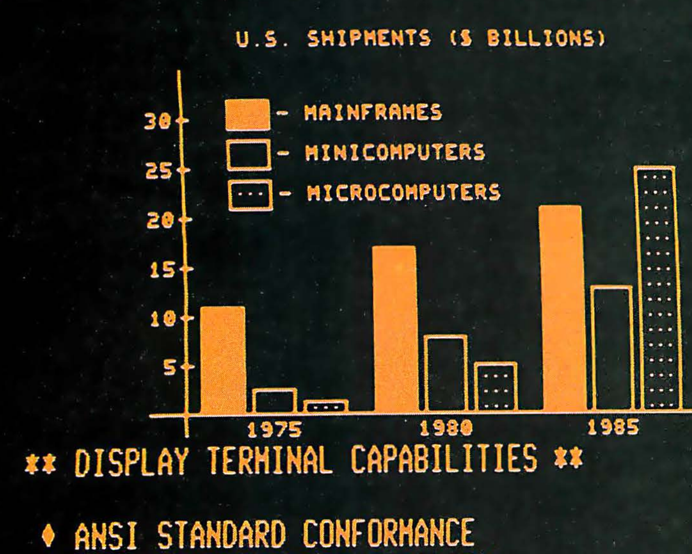
Epilogue

As indicated earlier, there are no winners or losers in this review of DataEase, Condor, and dBASE. Each program has its strengths and drawbacks. However, if you are looking for a DBMS program that has excellent interactive and data quality assurance capabilities and is relatively easy to master, DataEase should be considered. I was very impressed with its overall performance and features.

Condor and dBASE require considerably more time and dedication to learn and use. Condor does have good search, sort, index, and command file functions. It also offers a full range of relational features but does not permit interactive lookup or transfer of data among files.

For someone who wants the ultimate in DBMS flexibility, has or wishes to develop good programming skills, and is free to prepare complete applications in a step-by-step manner, dBASE may be a good choice. Database files can be set up quickly. And it is possible to add menus, special processing routines, and performance-enhancing utilities. ■

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for the preparation
west, and a dark stair
A dark chimney
window which is
brown sack, smell
sitting on the table.
around here
den door
d shut, a
hy case
lantern

LISP Slips

The LISP article (July, page 281) does not appear to have been reviewed before publication. These corrections cover only its first page.

MACSYMA's field is algebra, not calculus.

Eliza was not written in LISP. It was written in FORTRAN using the SLIP package of list-processing subroutines. The FORTRAN portions of Eliza and SLIP were later translated into MAD, and the MAD version was the one most widely demonstrated. There have been numerous reimplementations.

MYCIN is more therapist than diagnostician.

LISP was not developed from IPL. The IPL list-processing languages were developed at Carnegie Tech with minimal logical underpinning. They had the flavor of assembly languages for stack machines. LISP was developed around the same time, implementing theoretical ideas that McCarthy had developed at Massachusetts Institute of Technology.

The original LISP implementation was on the IBM 704, not the 7040. The 7040 designation was used for a solid-state version of the 704 that never caught on.

CDR stood for contents of decrement register, not data register.

Robert R. Fenichel
Phoenix, AZ

Your review of LISP for the IBM PC contains several misconceptions. Particularly aggravating is the sentence: "They [CAR and CDR] originally stood for Contents of Address Register and Contents of Data Register, respectively, on the IBM 7040." Sigh. On page 13 of *Anatomy of LISP* (published in 1978), I wrote: "These names [CAR and CDR] are hold-overs from the original implementation of LISP on the IBM 704. That machine had partial-word instructions to reference the address and decrement parts of a machine location. The "a" of CAR comes from "address," the "d" of CDR comes from "decrement." The "c" and "r" come from "contents of" and "register." Thus car could be read "contents of address part of register."

So the a and d do not refer to registers and the d does not refer to data.

Furthermore, though I did implement LISP 1.5 on a 7040, that project occurred several years after LISP was installed on the 704, and that was over 20 years ago. But the LISP (both the language and the style) described in the review is also 20 years old. A modern LISP is also a general-purpose programming language (with first-class objects) and an object-oriented language (with classes or flavors). Its functional heritage has also re-emerged with more attention to functional objects. It really seems time to get the facts straight and get on with it.

John R. Allen
The LISP Company
Los Gatos, CA

Turbo Pascal

I enjoyed Tom Wadlow's review of Turbo Pascal (July, page 267). I have been using the compiler for about two months and agree that it is an outstanding product at a reasonable price.

I want to point out two potentially misleading items in the review. Mr. Wadlow states that Turbo Pascal has "no built-in way of converting integers to reals." This is false. As in any Jensen and Wirth (J&W) Pascal implementation, if R is declared a real variable and E is an integer expression, the assignment statement R:=E is valid. Similarly, an integer expression can be used as the argument for a real parameter in a function or procedure (see page 21 of Jensen and Wirth's *User Manual and Report*).

The review also claims that, in J&W Pascal, the statement WRITELN(OUTPUT, FOO) is legal when FOO is a variable of an enumerated type. This might be allowed in some extensions of Pascal, but it is definitely illegal in J&W, Pascal and the ISO Standard (see J&W, page 86, or Doug Cooper's *Standard Pascal User Reference Manual*, page 118).

Michael Main
Boulder, CO

A GOTO upon you for every potential or neophyte Pascal programmer you have discouraged by publishing Tom Wadlow's review of Turbo Pascal. Suggesting that Turbo versus BASIC is the real comparison and Turbo is not really Pascal in the midst of benchmark programs at which Turbo excelled is folly.

The test program referenced to J&W generates a compile error in Turbo as it will in any other compiler that conforms to Jensen and Wirth or ISO standards. FLOAT is not a standard function or procedure, so it should not have been mentioned as missing in Turbo Pascal.

Having used Turbo Pascal exclusively for a course on data structures and algorithms, I feel that the dominance of Turbo as a structured programming learning tool on small systems makes it more deserving of a Robert Tinney cover than the patronizing review it received.

Bob Johnson
Boulder, CO

The Turbo Pascal review was mostly factual, but I should point out one inaccuracy and one oversight.

First, contrary to your reviewer's statement, the short example program on page 269 is not acceptable in standard Jensen and Wirth Pascal; there is no provision in the language for input or output of user-enumerated data types from text files. See J&W, pages 84–86, where it is made clear that only data of types integer, real, and char can be read from a text file, and only data of types real, integer, char, or Boolean can be written. Almost all existing Pascal compilers will reject the test program.

Second, although it is true that Turbo has no method of building libraries of compiled procedures (page 272 of your review), it is quite easy to build your library routines in Pascal source text form, bringing these source files into an application program using the "include" compiler directive. This requires compiling the library files along with the program that uses them; because Turbo compiles so fast and links as it goes, this method gives you all the facility of a compiled library without a time-consuming link step.

Richard H. Balay
Denver, CO

I have a couple of notes on Tom Wadlow's

(continued)

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Turbo Pascal review. First, the ELSE clause in the CASE statement need not be preceded by a semicolon, and it can contain a BEGIN . . . END block. The example in the Turbo manual could just as well have read:

```
case Year of
  Min. .1939: begin
            Time := PreWorldWar2;
            write('The world at peace');
          end;
  1946. .max: begin
            Time := PostWorldWar2;
            write('Building new world');
          end
  else begin
    Time := WorldWar2;
    writeln('We are at war');
  end; {else}
end; {case}
```

The fault is not in the compiler (unless tolerance is a fault), but in the documentation, which fails to point out that the more Pascal-like syntax is available. Probably many users have noticed that when they are not looking at the manual they substitute the more sensible construction without much thought.

Also, Mr. Wadlow says that Turbo's typed constant produces a "read only" variable. If he means what I think he means, he is wrong. The manual calls it an "initialized variable"; you *can* assign values to it. You can use typed constants not only to save space but also to avoid the necessity of declaring variables in one spot and assigning initial values to them in another; then you can assign new values to them at run time.

PETER S. BAKER
Atlanta, GA

We use Pascal for program development. We have found that we can move our applications to many different systems. News of new Pascal compilers is particularly important to us, so your review of Turbo Pasal was most welcome. Unfortunately, Mr. Wadlow missed using the most important tools for evaluating a Pascal implementation and thus presented an incomplete and inaccurate review.

The British Standards Institution (with the American National Standards Institute's support) has developed sophisticated, easy-to-use tools for testing Pascal systems. These include the Pascal Validation Suite (734 test programs) and the Standard Pascal Model Implementation (a complete and valid compiler and interpreter). All serious developers of Pascal systems use these tools.

We would be glad to provide any reader with detailed information on BSI's Pascal compiler validation services. Send a stamped, self-addressed envelope to the address below.

RICHARD J. CICHELLI
Software Consulting Services
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In his Turbo Pascal review, Tom Wadlow is right about the violation of Pascal grammar in the CASE statement default (ELSE without a BEGIN . . . END for multiple line block—the other clauses certainly require this).

On the other hand, he is wrong about typed constants. These are in-line static variables, similar to those in C (they can be used as local variables to carry values between subsequent calls of a procedure or function, and they have the advantage of maintaining locality of the variable). Assignments to these "constants" is possible, and the manual confirms this. Calling these variables constants is a far greater violation of the spirit of Pascal then the CASE. . . ELSE grammatical complaint; a constant should, after all, be constant. This style of variables is useful, but it should be provided as a class of variable.

The author contends that Turbo Pascal has no built-in FLOAT function. In fact, INT will accept an integer value and convert it to floating point (quite unlike BASIC where INT returns an integer value). The documentation on the INT function mentions that it accepts both integer and real values and returns a real value. I don't have a copy of Jensen and Wirth to check this against, so it might be quite proper although it feels incorrect.

The new version of Turbo Pascal (2.0) includes standard heap management (DISPOSE, NEW) and simple overlays. The author is not at fault here, but I feel this should be mentioned. A more serious omission occurs when the reviewer fails to emphasize the degree of upward compatibility between the 8- and 16-bit versions.

I have noticed one obscure problem in Turbo Pascal when I want to compile to disk and specify the starting address for the compiler code. The .COM file generated includes all the unused memory, so even a short program that starts in high memory can become huge. My only other complaint is that the Turbo menu does not provide any method for eliminating unwanted files.

As a final note of interest, Turbo Pascal lets the programmer change the value of a loop index variable, but this does not affect the number of times that the loop executes (apparently Turbo uses an anonymous loop index to count repetitions and performs operations on the named index variable separately).

ALLAN R. MCCOY
Lafayette, IN

Regarding your review of Turbo Pascal and your reviews of compilers generally, I would like to make a request. Please include in the review the precision of mathematical calculation that the compiler supports in its library functions and how extensive those library functions are for mathematical purposes. Also, it would be nice to see more in-depth review of the characteristics of the I/O library.

If you don't know how precise the mathematical capability is or the idiosyncrasies of the I/O, you might find that while adequate and inexpensive for general purposes, the compiler cannot satisfactorily perform specific applications—perhaps the reason you are buying the program.

DONALD B. SLAUGHTER
Seattle, WA

ELUSIVE 80187

You recently carried a product description of the Tandy Model 2000 MS-DOS microcomputer (March, page 306). In this article, Rich Malloy referred to a new product called the Intel "80187 floating-point numeric processor." We have received several inquiries about this chip.

In fact, our current production part, the 8087 Numeric Data Coprocessor, works with the entire 8086 family of microprocessors: the 8086, 8088, 80186, and 80188.

To use the 8087 coprocessor with an 80186 or 80188, the designer would use the 82188 Integrated Bus Controller (IBC). Literature on the IBC is available through Intel's Literature Department, 3065 Bowers Ave., Santa Clara, CA 95051, order #231051-001.

LYNN MCLEOD
Intel Corporation
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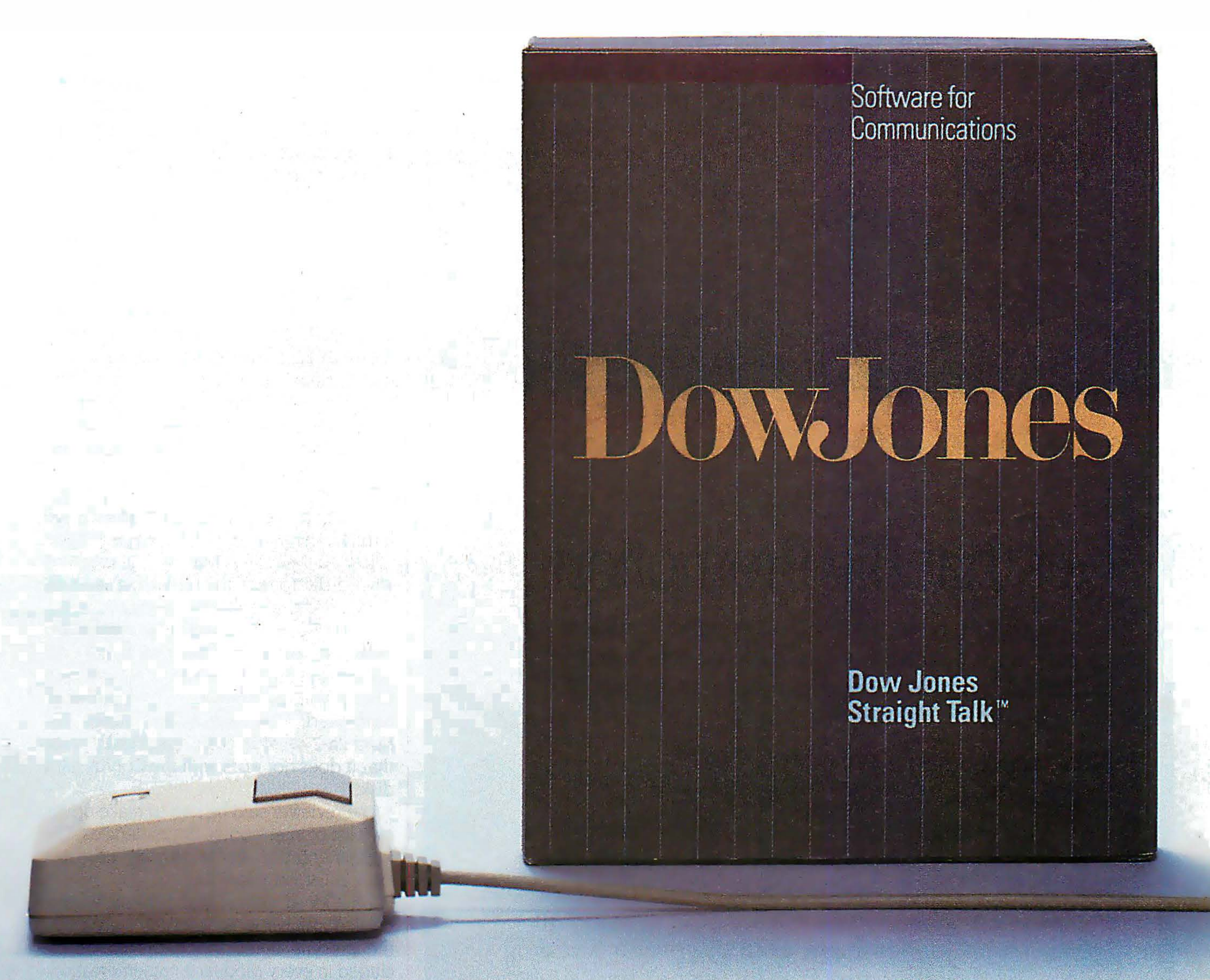
ATARI IN BUSINESS

We would like to provide an update on our review of the ATR8000 disk interface for the Atari 800 (December 1983, page 329).

In January of 1984 (well after we wrote the article), new regulations from the FCC

(continued)

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went into effect concerning RF (radio frequency) emissions from home computing equipment such as the ATR8000. Because of the many cables that act as transmitting antennas when hooked up to the ATR8000, it could not pass the requirements for a home computer but could pass the requirements for a business computer. Hence the ATR8000 is now being sold as a business computer with 64K bytes of memory, and the manufacturer is not allowed to manufacture and sell the home version that has only 16K bytes of memory. The manufacturer can, however, sell units already manufactured.

Many dealers still stock the 16K version, particularly mail-order houses.

David and Sandy Small
Austin, TX

Modula-2

On behalf of Volition Systems, I'd like to thank BYTE for publishing the review of our Modula-2 (June, page 353). Eric Eldred deserves credit for his thoroughness in testing the software; however, many of the problems he encountered were due to his not reading the documentation.

The reviewer said that there is no overall summary of the manual. In the seven-page introduction is a section (on page 4) titled "How to Use This Manual." It explains what order to read the remaining sections in to avoid the problems he encountered.

If Mr. Eldred had read the installation notes, he would not have had to ruin the contents of his Corvus hard disk and then phone Volition Systems to find out what happened. The installation notes for Modula-2 version 0.3K specifically state that it does not work with the Corvus hard disk.

The reviewer said he had to make up his own list of intermodule dependencies. The implementation guide already contains such a list on page 23.

Mr. Eldred claims that Niklaus Wirth's book (*Programming in Modula-2*) states that the module LineDrawing should be included in every Modula-2 implementation. This is not true; Wirth makes it clear (on page 113) that this module is only a suggestion—not a standard.

Other than these problems, the reviewer was generally on the mark. The BYTE benchmark results were apparently switched; the execution time with range checking off is 322 seconds, not 375. Also, Volition Systems' Modula-2 programs are portable at the source level but not at the code level.

The long integer problem described in

the review is fixed on our current Modula-2 release (0.3n). Right now we are working on a new release that fixes the Corvus hard-disk problem and uses the full 128K bytes of memory available in Apple Pascal 1.2.

RICHARD GLEAVES
Volition Systems
Del Mar, CA

WANG UPDATE

I read my letter (June, page 378) regarding the Wang Professional Computer with mixed feelings. I know it takes some time for a letter (or an article) to be published, but my letter was so dated that much of the information isn't correct.

But more important is an error I made. I referred to Wang's PC Database software rather negatively; at the time, Wang had not released the software for sale.

Recently support has improved in my area; I have located people who can provide pre-sales support and answer other questions. The people manning the PC Hotline are catching up. Although there is some delay in making contact with a representative (anywhere from three minutes to a day), once you make contact you will most likely get your answer during the same conversation.

In my letter I also complained that extras ordered with a computer had to be installed by the user. The company I work for has received two more machines since; the expansion cards and second drive were installed in both machines.

It has become much easier to use a non-Wang printer. The system software shipping with PCs now is version 1.22; among other nice features it includes a printer support menu. This menu has selections to let you fill in tables to create a printer driver. Tedious labor is involved and you need the printer's manual, but the ability to write a printer driver for most serial and parallel printers should be fully appreciated. This system software is also available as an upgrade for $100 (part number UJ3199).

KANDACE L. MYERS
Mechanicsburg, PA ■

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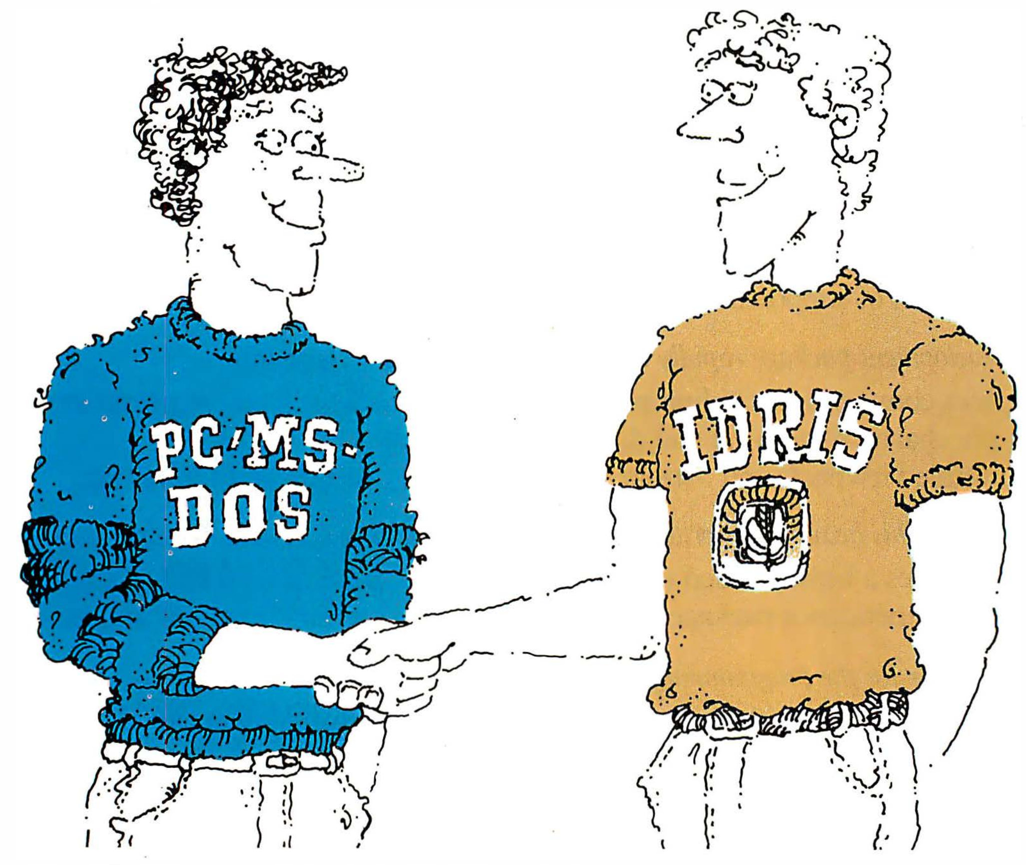
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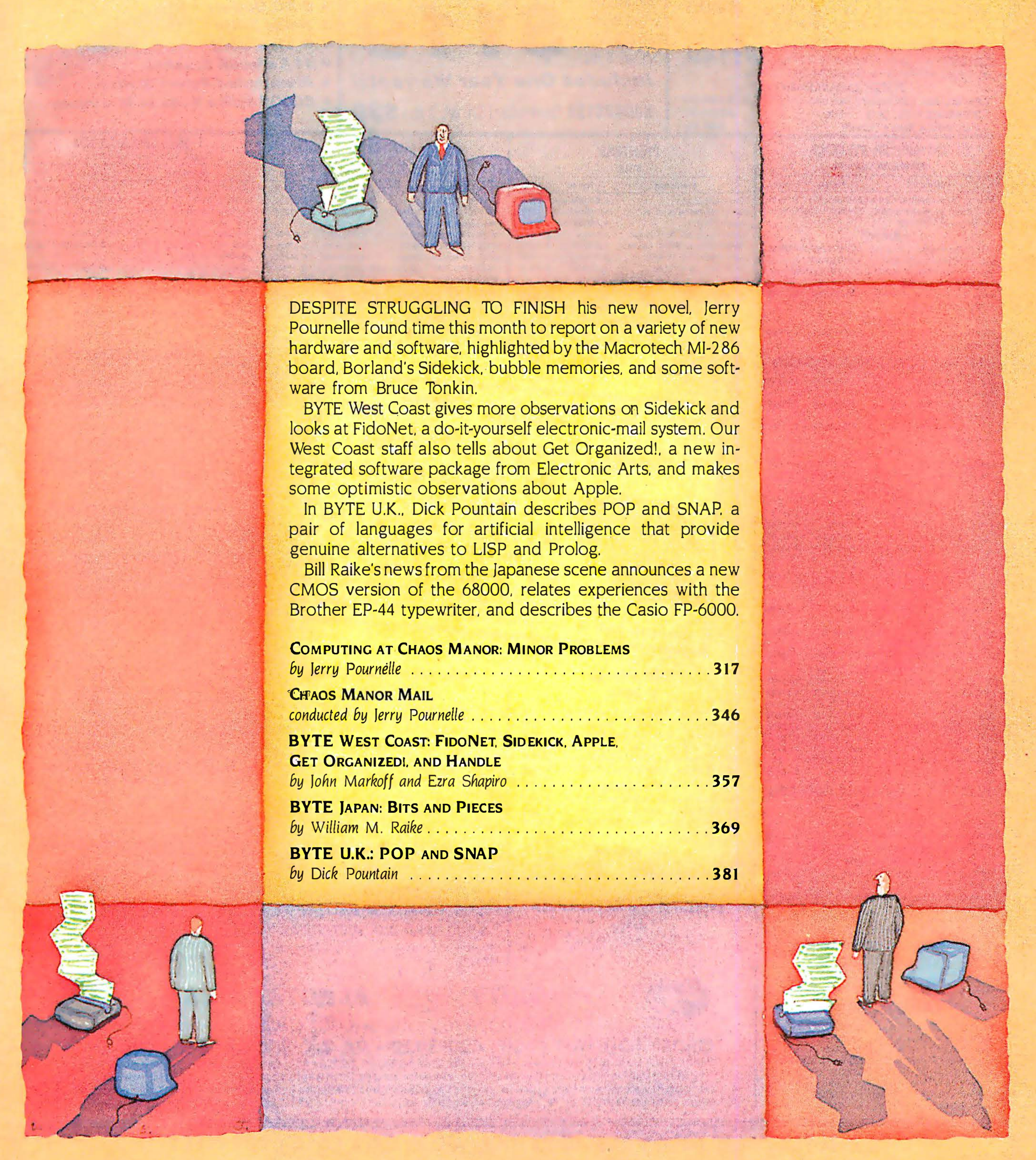
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Kernel



DESPITE STRUGGLING TO FINISH his new novel, Jerry Pournelle found time this month to report on a variety of new hardware and software, highlighted by the Macrotech MI-286 board, Borland's Sidekick, bubble memories, and some software from Bruce Tonkin.

BYTE West Coast gives more observations on Sidekick and looks at FidoNet, a do-it-yourself electronic-mail system. Our West Coast staff also tells about Get Organized!, a new integrated software package from Electronic Arts, and makes some optimistic observations about Apple.

In BYTE U.K., Dick Pountain describes POP and SNAP, a pair of languages for artificial intelligence that provide genuine alternatives to LISP and Prolog.

Bill Raike's news from the Japanese scene announces a new CMOS version of the 68000, relates experiences with the Brother EP-44 typewriter, and describes the Casio FP-6000.

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COMPUTING AT CHAOS MANOR

Minor Problems

BY JERRY POURNELLE

Jerry Pournelle holds a doctorate in psychology and is a science-fiction writer who also earns a comfortable living writing about computers present and future.

I've started this column in a blue funk. Fortunately, it won't last. My problems are strictly temporary. Still, they seem problem enough now.

First, Larry Niven and I didn't quite finish our novel *Footfall* last month. We worked daily, and we got a lot done, but there are three—maybe as many as five—chapters to go. True, we'll have them done in a week or so, but it's frustrating. I thought we'd be finished.

Second, the Golem, my big CompuPro System 8/16, is on the disabled list. I have no doubt that Tony Pietsch will have him up and going in a day or so. It's my own darned fault, anyway, for trusting double-sided tape. What happened was that two nights ago I was using the 8/16 to collect my mail on the net, and I noticed that his case was not just warm but nearly hot to the touch. I quickly looked at the fan filter, but I'd cleaned it a day or so before; that wasn't the problem. The machine was working fine, but it sure was hot, and finally I took the cover off to see why.

The telephone-connection box, which had been connected to a side wall with double-sided sticky tape, had fallen in such a way as to block most of the airflow from the fan. I fixed that and put the cover on, and I even used a small fan to blow air into the box while leaving it to cool off. The next day, though, when I turned him on, the Golem wouldn't boot. I've spares for nearly every board: processor, memory, Disk One controller for the 8-inch drives, System Support Board, so I swapped each one in turn; each time I got the same symptoms. I've written down everything I did, and I'm sure all will be well in a day or so—but the frustration is amazing.

It's only been a few hours, but I miss that hard disk. The Golem also drives my NEC Spinwriter printer. True, I have kludges to let Zeke II, the CompuPro Z80 I'm writing this on, drive printers, but it isn't the same. It's difficult to connect Zeke up to the Printer Optimizer print buffer; and worst of all, my accounting system and the check-writing stuff all run off the Golem's hard disk, so I can't even pay my bills. Today is, of course, the Fourth of July, and I don't know where Tony is. Sigh.

Eleven a.m., 5 July: a five-minute telephone call took care of *that* problem: blown fuse. It took Tony about three minutes on the phone with me describing symptoms. For a second he was concerned that in my board swapping I'd set some switches wrong, but I assured him I had done no modifications to the original boards and they were all back in the machine. He thought for a second and told me which fuse it was; I needn't have tried the board substitutions at all. In my defense, the fuses in the CompuPro machines are not where you easily see them; they're on one wall of the box, next to those intimidatingly fat capacitors.

Anyway, all's well with my 8/16. I *love* that hard disk.

MINOR MALAISE

My third gripe concerns a couple of readers. Once again I suppose it's my fault.

In the June issue I described some of the problems I'd had with the early test installation of the hard disk on my CompuPro 8/16 and how they were fixed. I thought I'd made it clear, in that issue and in many previous ones, that I'm a computer *user*. I do not really understand the hardware in the machine, nor do I want to. I can, if I have to, read instruction sheets and make minor adjustments, but I don't like it, and I don't claim fully to understand what I'm doing.

A few people read the June issue as an attempt on my part to make me look smarter than Tony Pietsch; and, of course, they had nothing better to do than look him up and tell him their theory. I suppose that if one or two could get the wrong idea from that column, others may have.

For the record: Tony Pietsch, unlike me, really knows what's happening inside these

(continued)

machines. He designs boards (such as the CompuPro S-100 IBM PC-compatible video board) and writes operating-system software, and if it weren't for him and my late mad friend Dan MacLean, I wouldn't have got started in this business. I'd apologize to Tony, except I don't need to. He's not that easy to upset.

TMX BIOS

On that score, CompuPro is now supplying Tony's TMX BIOS (basic input/output system) for those running CP/M-8/16 on CompuPro "boat-anchor" systems. It's fully debugged; I've been running it for months now with no glitches. CompuPro's policy is to give a free update to those who bought their systems after May 1, 1984, and to sell updates at $100 to those who got them earlier. The TMX BIOS works with or without the hard disk; knows about M-Drive/H memory drives; and can run with or without interrupts. When it's interrupt enabled you have full type-ahead, meaning that while your machine is doing one thing, you can type in the commands for what it's to do next. That's one of those features I never thought I'd want until I had it, and now I can't imagine how I ever got along without it.

CP/M-8/16 used with a Dual Processor CPU (central processing unit) uses the 16-bit chip to control disk operations and stores most of CP/M in high memory above the 64K-byte boundary. The result is a much larger temporary program area (TPA; it's the system's "workspace"), even for 8-bit programs. As an example, my favorite text editor WRITE has a 33K-byte workspace on Zeke II and 40K bytes on the Dual Processor using the TMX BIOS.

The TMX BIOS also uses full track buffering for disk operations, meaning that reading and writing to both hard and floppy disks are speeded up something wonderful. The TMX BIOS understands both 5¼- and 8-inch disk drives, and Tony has done a program that lets the CompuPro Disk 1-A controller board read, write, and format about 50 different 5¼-inch variations.

Finally, he's done something to the CP/M Command Processor. When you invoke a command file, the program first searches current user, currently logged disk; then current disk, user 0; then Drive A:, current user; and finally, system files under user 0, Drive A:. This means that often-used command files can be stored as system files on A0: and forgotten; when you need them, you'll have them like magic.

There are other goodies. You get source code and full instructions on how to configure your system and install it. Tony's code can be assembled with the Digital Research assembler that comes with CP/M-86; you don't need the dreaded Sorcim ACT assembler to get it working.

One caution: the instructions are complete, but they aren't entirely clear to naive users. If you don't know what you're doing, arrange to get help from someone who does or prepare to do some careful reading. As I write this there's no cookbook, although that could change. At all events, the resulting upgrade is more than worth the effort. Those using CP/M-8/16 with CompuPro equipment will not regret updating to Tony's TMX BIOS.

It also works with other systems . . .

Macrotech Moves Ahead

The other day Tom Harincar, president of Macrotech, and Frank Nichols, one of his hardware gurus, came over with a preproduction model of the Macrotech MI-286 processor board. This little wonder has an 8-MHz Z80h and a 6-MHz 80286 on a dual-processor board.

They wanted to test the system on my Golem with the TMX BIOS. We opened the box, removed my CompuPro Dual Processor 8085/8088 board—mine has Jim Hudson's 8-MHz 8087 math processor board attached—and dropped in their Z80h/80286 processor board.

It almost worked. My system has a lot of CompuPro RAM 21 boards; it turns out that three of my boards will work with the Macrotech board. The fourth had some timing problems with their processor although it always worked fine in my system. Macrotech swapped me one of its RAM 21s for my "problem" board so that its people can restudy the situation; since CompuPro owns much of the S-100 market, Macrotech's people want to be sure their stuff is compatible with CompuPro's equipment.

After the one problem board was out, the system worked fine. The Macrotech crew then put in their 512-ST half-megabyte static-memory board, and we tested it with both the CompuPro Dual Processor and Macrotech's MI-286. Both worked splendidly, with no changes to the rest of my system.

The MI-286 is *fast*. That 8-MHz Z80h causes WRITE, and The Word Plus, and my accounting programs to just *fly*, and the 80286 makes the disks work like lightning. Typical time savings on big disk-directory sorts: jobs that took 11 seconds with the CompuPro Dual Processor took 7 seconds with the Macrotech MI-286. Large multiuser area-directory sorts are a good test because they combine both processor and disk operations.

On a processor-intensive operation like my matrix-multiplication program, the time savings are even more impressive over the Dual Processor alone. However, the time improvements aren't so dramatic over the combination of the CompuPro Dual Processor and Jim Hudson's 8087 board.

Alas, I can't give exact timing figures because the MI-286 had some overheat-generated difficulties. This is nothing to be alarmed about; it's July and *hot* in Southern California, that 80286 chip generates enough heat to fry eggs, the 8-MHz Z80h isn't a lot cooler, and this is a preproduction board.

I'm sure that before you read this Macrotech will have taken care of any problems, if need be by adding heat sinks or changing the board layout. When it's all stable, I'll convert Zeke II, the Z80 I'm writing this with, over to the MI-286; I crave that fast Z80h and the big workspace I get with a Dual Processor and Tony's TMX BIOS. Meanwhile, I've been running my

(continued)

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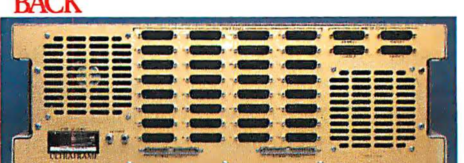
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system with the Macrotech MI-286 half-megabyte memory board: that memory is as fast as anything on the S-100 market, and there's been nary a glitch.

Macrotech is known for its dynamic-memory boards. Tom says that when his people have the MI-286 completely stable, they'll get to work on producing dynamic memory for it. At the moment they haven't seen a dynamic-memory-board design that's fast enough to justify using an 80286 with it.

DELAYED BASIC

I'd intended the lead item this month to be a discussion of the future of BASIC. The language is experiencing a real comeback. There's Steve Ciarcia's IBM PC Trump Card board that makes BASIC programs run from 10 to 100 times faster; and there's Morgan Computing Company's marvelous Professional BASIC, which is a BASIC programming environment that has features I haven't seen available for any other language.

Better than that, last year Microsoft quietly removed the licensing restrictions and royalty fees on distribution of programs compiled with the company's BASCOM BASIC compiler. BASCOM-compiled Microsoft BASIC programs run pretty fast. They're not as fast as C programs or those written in Turbo Pascal, but they're on a par with IBM Pascal and a lot faster than p-code.

Morgan Professional BASIC has a debugging system that should make writing BASIC programs a snap. I've seen it demonstrated, and I was really impressed. Alas, I've been too darned busy with *Footfall* to do justice to the program; and since my views on BASIC are in large part influenced by the existence of excellent debugging tools like Professional BASIC, as well as structured preprocessors like Bruce Tonkin's P-BASIC, I want to give some illustrative examples when I write on BASIC's future.

However, I have seen Professional BASIC, and I can only wish I'd had a debugging environment like that when I was writing Microsoft BASIC programs. If you have an IBM PC and you intend to do much BASIC programming, you'll do well to look into Professional BASIC.

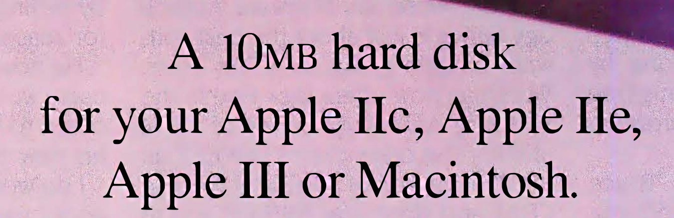
I have one complaint: Professional BASIC won't work with Magic Keyboard, and I find the IBM PC keyboard without Magic Keyboard something less than tolerable. I've spoken to Chris Morgan of Morgan Computing about this, and he says he'll look into ways they can modify Professional BASIC to let it work with reconfigured keyboards. They may

(continued)

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*If you do not have a Duodisk, or use an Apple III, a special cable is available. See your dealer for details.

**Catalyst works on the Apple IIc, IIe and Apple III. It is not compatible with Macintosh.

Photography by Barbara Kasten

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have to build the keyboard configuration directly into Professional BASIC.

Prediction: the new BASCOM policy, Professional BASIC, and Tonkin's structured P-BASIC preprocessor have put BASIC back in the running as a major production language.

T.N.T.

I have an 18-pound box from Bruce Tonkin's T.N.T. Software company. It includes an index program that he uses for all his documentation; a database; My Word, a text-editor program that's darned near as good as any I've ever seen, including some features like calculations and sorts that aren't in *any* major text editor, and it sells for a pittance; his structured P-BASIC; and a whole raft of other wonders. It all works, and at prices from $25 to $50!

Tonkin is amazing. We suggested a need for a terminal emulator for the IBM PC, and he had one done in two days, with further refinements like transferring files from the PC to a CP/M machine it's controlling and vice versa three days later. Working by himself, he produces more bug-free software faster than many program shops employing 20 people.

Like most programmers, Bruce Tonkin used to sell his own products; his wife and children and their friends helped out with duplicating disks and documents, packaging the stuff, shipping, and the rest of it—an onerous chore. There's also the problem of disk formats: there are about 50 nearly incompatible 5¼-inch systems, and stocking some of each is burdensome. Running a responsible mail-order business is a time-consuming process, one I'd have tired of long ago. So, I suspect, has the Tonkin family, but they're concerned: they don't want unhappy customers for Bruce's creations, and their prices are low enough that many software distributors simply aren't interested.

You can still buy any of his software direct from Bruce at T.N.T., but recently he made a deal with Barry Workman to handle most of the T.N.T. product line. A few special formats, like TRS-80 Model I, will stay exclusively with T.N.T., but most of the CP/M, Macintosh, and IBM PC products will now go largely through Workman. That should free up enough time for Tonkin to produce even *more* software. He's certainly capable of it.

Bruce Tonkin is one of the last of the hobbyist programmers who made good without starting up an enormous high-hype company. His success story shows that you can do well by doing good.

More Utilities

Barry Workman is another who's done well by doing good; Workman and Associates was one of the first mail-order software houses to offer unconditional money-back guarantees, and Barry really works at customer satisfaction.

Sarge Workman is an old friend, and my son Alex works over there as a programmer, so I'm not unbiased; but I'm willing to defend the proposition that the Workman Software Anthology Series is just about the best software bargain going for CP/M users. Workman now offers Disk Five in the Software Anthology Series of CP/M utilities. This one includes LSWEEP, an updated version of SWEEP; if you use CP/M and don't use SWEEP, you're working far too hard.

It also has SUPERSUB, which is a jazzed-up version of SUBMIT that lets you put control characters in the SUBMIT files. You can also put in null lines and *nest* SUBMIT jobs.

For those who don't have them, either of those two programs is worth what Workman charges for the whole disk.

There's also XPIP, an improved PIP; ERAQ, an interactive erase utility; PATCH.ASM, which shows how to patch CP/M 2.2 to have the prompt display user number; another patch to let the CP/M command processor respond to both the backspace and the delete character without echoing; FF.COM, which will send a formfeed to the list device; UNLOAD.COM and UNLOAD.MAC, which take .COM files and turn them into Intel hex files; an older but very useful version of Tony Pietsch's XD.COM, one of the most useful utilities I have; and NSWP206, a copyrighted disk-maintenance utility that's worth *more* than the price of Utility Disk Five. It includes the ability to compress files using the SQUEEZE and UNSQUEEZE utilities as well as doing everything SWEEP does.

As usual, Workman has taken utilities from a number of public-domain sources and combined them with copyrighted programs on which he pays royalties. The public-domain programs have been worked over, with documentation improved and bugs removed.

The Software Anthology Series is available in 8-inch IBM standard format and about 35 different 5¼-inch formats. I particularly recommend Disk Five of the series.

Borland Does It Again

Philippe Kahn's Borland International company shook up the micro world by selling the excellent Turbo Pascal for reasonable prices.

He now has a product that IBM PC users won't be able to do without. He ought to sell about a zillion copies of his new Sidekick program.

I do wonder where Kahn gets these goofy names. Turbo Pascal was bad enough; now I have to write about Sidekick. Alas.

The name's rotten, but the program is wonderful. Sidekick is a multiwindow utility program that resides in your IBM PC's memory. You can run other programs, but Sidekick is always there waiting. It contains a notebook (which has the Turbo Pascal text editor, similar to the UCSD Pascal editor but with more WordStar-like commands built in); a calendar; a *good* desk calculator with memory, unlike the crummy one that Apple put into Macintosh; and, wonder of wonders, an ASCII (American Standard Code for Information Interchange) table that shows IBM PC graphics characters. It also shows control characters and their standard ASCII mnemonics (NUL, SOH, ETX, etc.). Included are the decimal and hexadecimal values. Incidentally, the calculator will instant-

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ly convert from decimal to hexadecimal to binary. No octal, but I don't use octal anyway.

There's a telephone dialer to use with your modem. It's also the Rolodex: you can make entries like

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and the dialer will pick out the number for you. The entries can be made by the Notepad or can be dragged in from your own database. Since the Notepad has a search function, finding phone numbers turns out to be fairly easy.

Philippe Kahn tells me he uses Sidekick with an IBM PC, then uses Crosstalk to fool the PC into thinking it is a TeleVideo 920 terminal; he then uses the PC to operate other computers but has Sidekick available all the time. That sounds great, and we just got Crosstalk with a view to making our PC control the Golem and also (through a T-switch) be one of the four terminals for Shirley (our CompuPro 10) as well as the terminal for the Sage IV. That will give me Sidekick available for notes, calendar, calculator, and telephone calls; Steve Ciarcia's Z8000 Trump Card for running quick-and-dirty BASIC programs; and all the capabilities of my other systems.

It's always seemed ridiculous that I've had to keep desk calculators next to a whole wall full of computers. Senseless it may have been, but the alternative was to save off whatever I was doing and load in BASIC or a calculator program; and that took too long. I suppose half the program-development workstations in the country have a TI Programmer hexadecimal calculator next to the computer keyboard. I certainly did until this week.

One of the things I liked about Apple's Macintosh was a calculator continuously available, but alas, like much of the Macintosh, the idea was good but the execution was execrable. The Macintosh calculator is Macuseless. Sidekick's is not.

Sidekick has a couple of problems, and I'd like to see a few new features. One thing I miss is the change-signs function on the calculator. No matter. I make no doubt that Borland will do updates; and right now the program is invaluable.

Sidekick does take up memory, about 56K bytes. There are ways to make it use less by giving up some of the Sidekick functions. Given the rapidly falling price of memory, it hardly seems worth it. I greatly prefer the convenience of Sidekick to the memory it costs.

If you use a PC, get Sidekick. You'll soon become dependent on it.

Copy Protection Yet Again

I once swore I'd never recommend a copy-protected program. Sidekick is copy protected, and I sure recommend it. Now what?

First, Philippe Kahn's side of the story.

Borland doesn't copy-protect Turbo Pascal. The disk isn't a lot of use without the documents, and the thick book that comes with Turbo would be a lot of trouble to copy. In addition, except for schools, not many places would use a number of copies of Turbo, and of those, most would buy multiple copies.

Not so with Sidekick. Philippe tells me horror stories of big companies that routinely buy one copy of a program, then make 30 and more copies for internal distribution. Sidekick needs no documents. It comes with an attractive, indexed manual, but it has on-line Help files that are nearly good enough to teach the use of Sidekick without manuals—and are certainly good enough that you'll probably never use the manual after the first week. The manual itself is thin (73 pages, including the index) and easily copied.

If Borland didn't copy-protect

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[1]Lotus Development [2]Ashton-Tate [3]MicroPro [4]IBM Corporation

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Sidekick, a lot of places would buy one copy and use it in 10 and more installations.

Second, the copy-protection scheme isn't onerous. Once you load in Sidekick, you can remove the master disk and put it away. You don't need it again until you turn the machine off. It's not even very sophisticated. Philippe reckons that any good hacker can defeat the copy protection in about an hour, and as far as he's concerned, they're welcome to do it; he's not trying to stop hobbyists and programmers from making backup copies but to stop wholesale rip-offs by big outfits.

Third, there's the price. Sidekick is $49.95, down there at the high end of the cost of a hardbound book. We don't expect publishers to give us free backup copies of reference works, nor do we routinely make copies ourselves; why should software be treated so much differently?

Those were Kahn's arguments.

I'm still thinking about the situation. I do not like copy protection; but I can see Kahn's point, particularly regarding companies that make a policy of illegally—and unethically—copying software for multiple simultaneous use.

I've always said that the ethical practice is not to restrict which machine a program runs on—it's silly to insist that a user repurchase all software when upgrading to a new machine—but rather to insist that only one copy of a program be in use at any one time. This is a close analogy to books: many people can read them, but it's unethical (and illegal) to make copies and either give or sell them to friends.

The kind of copy-protection scheme used by Kahn, and by Living Videotext on the excellent ThinkTank, accomplishes this. There's still the problem of disk destruction. I've got to think about this some more.

BUBBLES . . .

Several months ago I installed the Helix Bubble Memory board in Lucy Van Pelt, our fussbudget IBM PC. It works like a charm. The PC thinks it's a very fast hard disk.

Bubble boards have no moving parts, and once something is written to the board, it's permanent; not only is it immune to power failures but you could take the board out and mail it to a friend as an expensive way to transfer software.

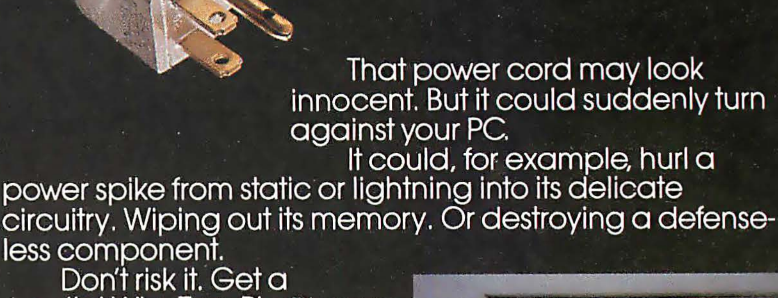
The problem with bubble memory is that it's pretty costly for the amount of information stored. At $1500 for half a megabyte the Helix board was rather overpriced, considering what you'd pay for a hard disk and controller.

Intel recently dropped the price of bubble-memory chips, meaning that Helix has been able to cut the price

(continued)

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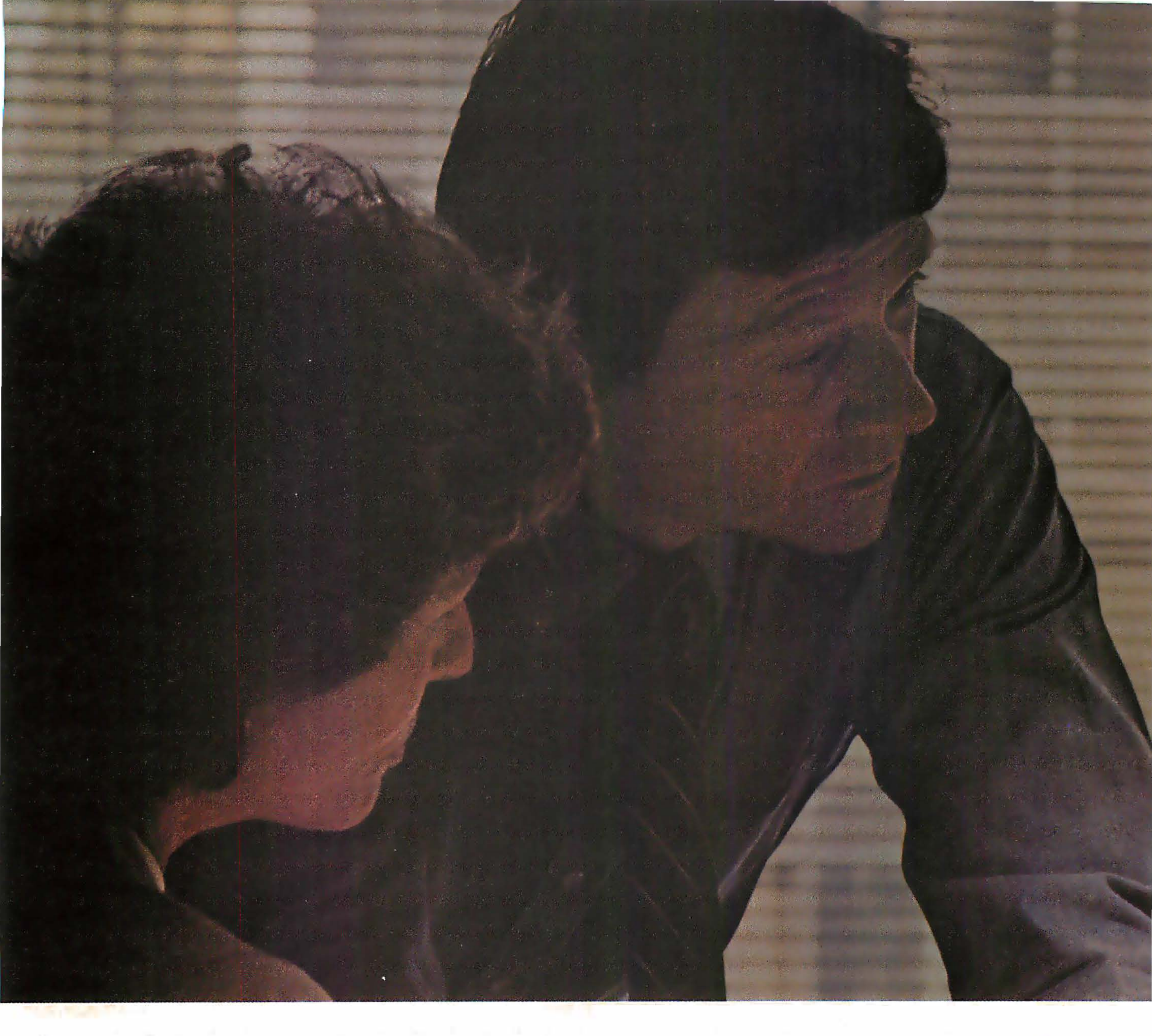


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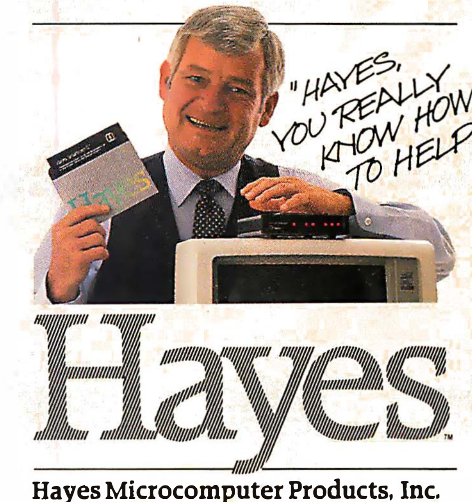
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of bubble memory. It's still not competitive on a megabytes-per-buck comparison, but it's no longer a frill either. Bubble memory is faster than a hard disk—and having no moving parts, it's safer. The Helix Bubble Memory board would be especially appropriate for a machine that had to operate in a harsh field environment or be carried about in a Jeep. I suppose that one day I'll replace it with a hard disk simply for the larger capacity, but I'm in no hurry. I like the speed and reliability I get with the Helix.

One day—probably well before the turn of the century—hard disks will be obsolete. Mass storage will not use moving parts. It may be bubble memory (greatly reduced in size over the present bubble chips) or something else, but you won't lose betting that systems requiring high-precision machined parts are on the way out. Of course, it will take a while to replace them . . .

Le Cafard

Recently I've seen a great deal of speculation about the origin of the term "bug" to describe a computer problem. The most widely accepted story is that an actual moth was found blocking relay contacts in an early electromechanical computer.

That story may well be true, but it's unlikely to be the first use of the term "bug."

During the fifties and sixties, "I'm bugged" was considered an explanation of sorts for bizarre activities, such as a man leaving his wife so that he could hitchhike to Tijuana. Those hip to the jargon probably considered the term original with their generation.

It wasn't. As early as 1850 the primary malaise of *La Légion étrangère* was *le cafard*—which literally translates as "the bug." *Le cafard* was, and probably still is, the generic excuse for Foreign Legionnaires to be irritable, stare at the wall, assault superiors, attempt to desert, be off their feed, etc. *Le cafard* was a small beetle that was imagined to have crawled in the ear and penetrated the brain, thereby causing madness. Legion officers swore that the only real cure for *le cafard* was a rifle and the opportunity to use it.

It would be interesting to trace the exact way that the Legion's *cafard* managed to creep into our computers.

IBM Catches Wise

Rumor department: I have sources for this, but obviously I'm not going to name them.

It has been interesting to watch.

Because of the IBM PC, for the past three years a larger and larger per-

(continued)

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centage of IBM employees have become IBM customers. They've had to learn the hard way what it's like to deal with Big Blue from the outside. A lot of them are not happy. The result has generated a quiet but real rebellion within IBM.

For example, IBM employees get big discounts when they buy an IBM PC. However, for much of last year, the local ComputerLand stores simply couldn't get as many PCs as they could sell. Thus, if IBM employees tried to order through ComputerLand, they'd find themselves waiting a long time. The ComputerLand managers would naturally rather sell any PC they could come by at full price rather than deliver one to an IBM employee at a profit-killing discount, so when a PC came in, it would often be diverted to a non-IBM employee.

Meanwhile, the IBM Product Centers were better able to get IBM PCs—but the word went out among IBM employees. Better to wait forever and get your discounted PC from a ComputerLand than have to deal with an IBM Product Center. The frustration level of dealing with Product Centers verged on intolerable.

As I said, this is all rumor from "Deep Blue," my source inside the company; I don't guarantee any of it. However, I do understand that IBM's management has got The Word, and the Product Centers are changing.

Another interesting development: until very recently, IBM did not use the inventory and bookkeeping software it sold for its own internal use. The company had computer systems, but it also relied on shipping mounds of paper back and forth across the country. In the last couple of years, though, IBM decided to bite the bullet and use the stuff it's selling.

The result has been a number of salutary improvements in IBM software. When you have to use the stuff yourself, you begin to *care*.

Score more points for the micro revolution.

The Index Dilemma

About the time you read this, the first book in the Pournelle Users Guide to Small Computers series should be available from Baen Books. The cover is by Robert Tinney, who does the BYTE covers. Jim Baen says that everyone who sees that cover just smiles and smiles . . .

The book is in large part a collection of my columns with update material, including a previously unpublished section written as a letter advising my colleague Robert Silverberg on how to buy a microcomputer. Since it has my name on it, it naturally had to have an index. I may be crazy, but I'm not stupid; I've been far too severe on books without indexes to leave one out of mine.

(continued)

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Indexing should be an ideal job for a computer. Since the job had to be done during a month when I wouldn't be here very much, I turned the task over to Peter Flynn, our long-suffering editorial assistant.

WRITE, the text editor I use, keeps what it's working on in memory: books are thus broken up into chapter-length files. I find that very convenient, but it does leave something to be desired for indexing. More: all our index programs want to work with WordStar (which is a good reason why one ought to have WordStar even if it isn't used for text creation).

Peter's game plan was to concatenate all the chapter files into one or two long WordStar files, print out the document, and make an index keyed to the printed manuscript. It would then be only about a day's work for one of the publisher's copyreaders to take finished page proofs plus Peter's index and make an index keyed to the actual book pages.

He could have used Bruce Tonkin's index program. We also have an index program for the IBM PC that we got from Borland International. However, one of Peter's jobs is to test out software, and he had SuperDex from Spite Software (where *do* people get these company names?). We also have Oasis's wonderful The Word Plus, which includes a whole mess of word-handling utilities, including Wordfreq and Dictsort. Wordfreq will take any text and make a table of all the unique words sorted by their frequency of use. Dictsort will take a list of words and sort it alphabetically. The theory was to make a table of *all* the words, then eliminate the common ones and index the rest.

First, though, he had to concatenate the files. That's no great difficulty. The WRITE text editor now comes with FILTER.COM, a utility that Tony Pietsch wrote that will convert WRITE files to WordStar, WordStar to standard ASCII, ASCII to WRITE, etc. Tony's program is so fast that for a long WordStar file it is quicker to:

1. Save the file within WordStar.
2. Exit WordStar to CP/M.
3. Use FILTER.COM to convert the file to WRITE format.
4. Use FILTER.COM to convert the file back to WordStar.
5. Enter WordStar and read the file.

than it is to use WordStar's global reformatting command!

FILTER.COM will concatenate files; it was designed to make one big WordStar file out of a lot of small WRITE files so that we can use Footnote and some of the other WordStar utilities. Thus, merging the separate

(continued)

ITEMS DISCUSSED

Helix PC Bubble Memory Board
128K bytes $750
256K bytes $995
500K bytes $1445
Helix Systems
11601 Wilshire Blvd., Suite 720
Los Angeles, CA 90025
(818) 710-0300

MI-286 Processor Board $1395
Macrotech International Corporation
9551 Irondale Ave.
Chatsworth, CA 91311
(213) 700-1501

Professional BASIC $345
Morgan Computing
10400 North Central Expwy.,
Suite 210
Dallas, TX 75231
(214) 739-5895

Sidekick $49.95
Turbo Pascal $49.95
Borland International
4807 Scotts Valley Drive
Scotts Valley, CA 95066
(408) 438-8400

Star Fleet I (compiled) $49.95
postage and handling $2
Cygnus
POB 57825
Webster, TX 77598
(713) 486-4163

SuperDex Document-Indexing Software $59.95
Spite Software
13531 SE Foster Place
Portland, OR 97236
(503) 224-0137

The Word Plus $150
Oasis Systems Inc.
7907 Ostrow St., Suite F
San Diego, CA 92111
(619) 279-5711

TMX BIOS for CP/M-8/16 . . . . . see text
CompuPro
3506 Breakwater Court
Hayward, CA 94545
(415) 786-0909

T.N.T. Software . . . Contact for prices
Bruce Tonkin
34069 Hainesville Rd.
Round Lake, IL 60073
(312) 223-8595

T.N.T. Software . . . . $25-$50
Software Anthology Series
(five disks) $32.50/disk
Workman and Associates
112 Marion Ave.
Pasadena, CA 91106
(818) 796-4401

Trump Card $995
Sweet Micro Systems
50 Freeway Dr.
Cranston, RI 02920
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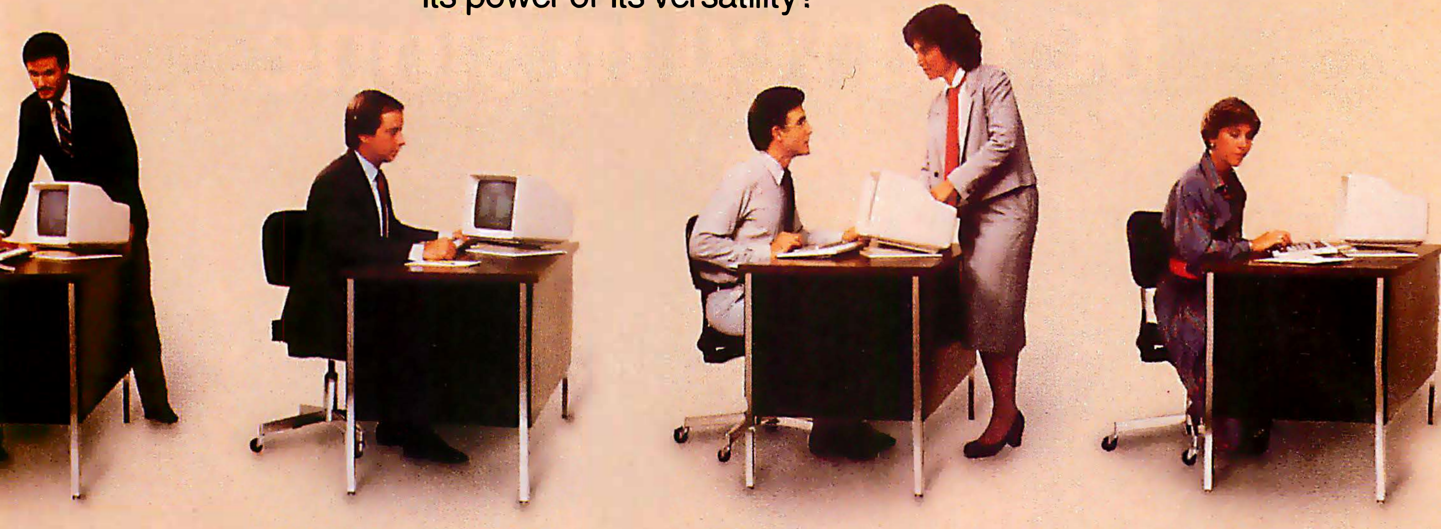
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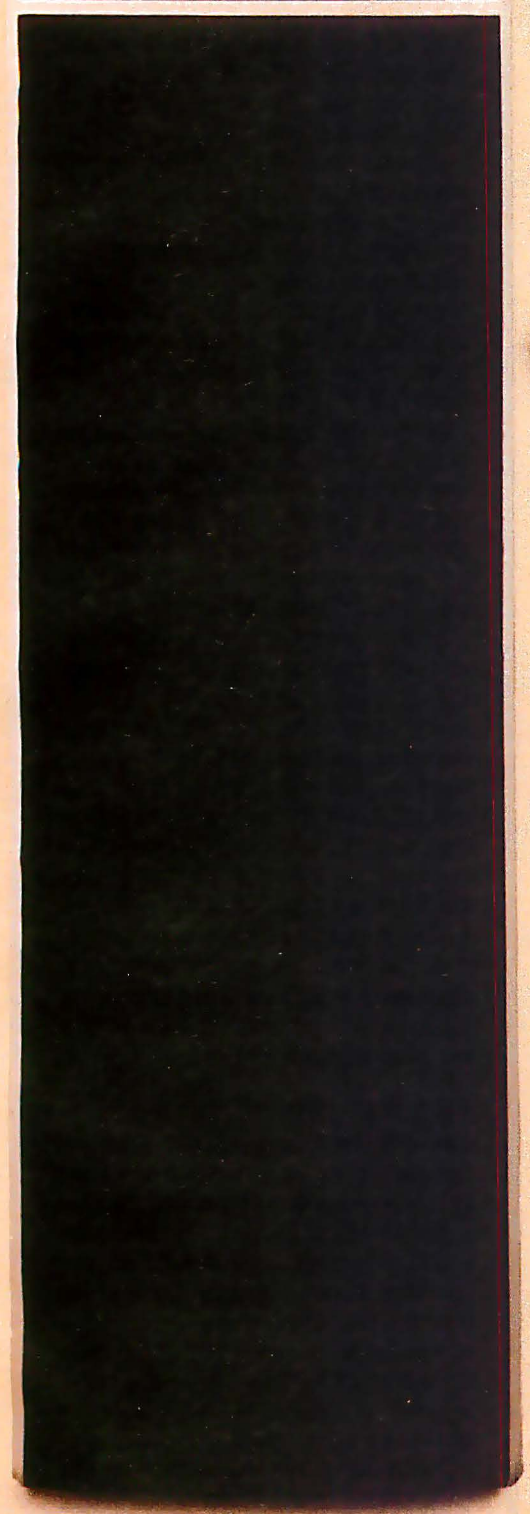
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WRITE files into two large WordStar files with FILTER.COM was quick and easy; it took about 25 minutes on Zorro the Z-100.

Printing the resulting documents wasn't so easy. Although FILTER.COM changes WRITE formatting (dot) commands into their WordStar counterparts, the conversion isn't perfect because WRITE has some formatting commands that WordStar doesn't have. As an example, WRITE allows both right and left headers *and* footers; WordStar doesn't. If you have both sides of a header or footer in use, WordStar doesn't print it all—and worse, it eats the *page numbers*. Since the point of this exercise was to get a page-numbered manuscript, this was a futile exercise.

At this point Peter made a mistake: instead of going back to the original WRITE files and removing headers and footers (which would have taken less than an hour; WRITE is *fast*), he tried to work with the two enormous (about 300K bytes each) WordStar files, searching through them for dot commands. WordStar is *slow* at this kind of work. It took him several hours. There was also the problem of disk space: WordStar won't do elaborate searches without making backup files. Eventually he got that problem solved.

File-size Blues

The next job was to get a list of unique words. Alas, Peter discovered that Wordfreq won't work with *big* files. It keeps its list in memory, and after reading through a document for many minutes, it can just give up and die with an "Out of Memory" error. Thus, it was back to FILTER.COM to chop up the WordStar files into manageable lengths. (FILTER.COM, with a whole bunch of other filter programs that convert files from one editor's format to another, is available on a disk of filters from Workman and Associates. I wrote some of the filters, and Tony wrote FILTER.COM at my request. I can't imagine living without these utilities.)

Eventually the job got done, and

(continued)

SuperDex scans the text and stops at any word or phrase you've told it to look for, then displays it and waits for a decision.

Peter had a list of words, such as BASIC, FORTRAN, documentation, CP/M, and the like. There was only one problem: many of the words that ought to be indexed occurred hundreds of times in the book. No index needs *that* many entries.

The SuperDex indexing program scans through the text and stops at any word or phrase that you've told it to look for. Then it displays it in context and waits for a decision. You can then include that instance in the index, make a modified index entry, or forget it. With words like BASIC, though, where there are hundreds of occurrences, it would take forever to make an index. Peter tried a number of ways around the problem, such as finding words associated with the searched-for words. Eventually he had his index search list.

When he tried it, he found to his horror that SuperDex's document tells you, in the back of the book, that the program won't work with files larger than 64K bytes in size, but it can work with a document spread out over a number of files, provided that each ends with a forced .pa (end of page). There was nothing for it but to go back to FILTER.COM; eventually he had 13 files of about 64K bytes each. Of course, using the forced end of page on each one changed the page numbering, so that the printed manuscript he'd started with was useless. The manuscript had to be printed all over again.

The Last Problem: Sudden Death

Peter's report continues:

"With all this done I started SuperDex. Everything seemed fine. My only complaint was the time it took to go through a page. It seemed that there were two words per sentence that SuperDex would find that matched my list of words to watch out for. Clearly, there were too many words in the 'look for' list. Still, I was worried that if I removed too many I might miss an important reference.

"The worst part is that SuperDex stops and redraws the screen each time it finds a new match. This really slows things.

"*Halfway* through the first file the program stopped and said it was done. I didn't have time to find out why. Six pages had taken almost two hours, and the index was already late. I was just about to do the entire index by hand when I realized that SuperDex could still work if used in a different way.

"SuperDex works in two steps. First it creates a raw index file that lists words and phrases along with their page locations in the document. It then prints a formal index based on the information from this file. It was the first half of the program that wasn't working properly. All I needed to do was read through the printed copy of the manuscript and jot down with a text editor any words or phrases that I wanted in the index along with their location, following the format of the SuperDex raw index.

"The resulting file looked like this:

```
Pcats
Ssmall gray ones
14
Pcats
S
47
Panimals
Scats
47
Pdogs
S
59
```

and so forth. Converted into a formal index, those (with other entries) came out

```
Animals
   cats, 47
   dogs, 59, 102
Cats, 47
   small gray ones, 14
```

"I found that to do a comprehensive index with plenty of cross-referencing and multiple listing it's still necessary to use the human brain to analyze in-

(continued)

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dividual words and their contexts. The best way is to read the manuscript yourself; having the computer seek out words and phrases actually slows you down if the index is of any significant size.

"An ideal program for me would not need to scan any documents but would keep track of all words you want to enter in the index, related page numbers, and cross-references or other duplicate entries you wanted. Once that's done it would print the index in proper form."

I think I recall seeing a program that works the way Peter describes: you go through a document and *mark* the words or phrases you want indexed, adding others (with special marks) as needed. The program then goes through and makes an index.

Alas, I seem to have mislaid that program.

We'll be producing many more books that need indexes, so there'll be plenty of opportunity to test other programs.

Wrapping Up

I'm out of time and space (not unusual for a science-fiction writer). I'd hoped to have time to play with some more goodies. We have ThinkTank for the Macintosh; I just got it, and I must say I'm very fond of what I've seen.

There's Idea Ware's The Idea Processor, which is a sort of combined card file and text editor for the PC. It looks to be valuable, and I suspect I'm going to be using it a lot.

I'd hoped to do a detailed report on Savvy, which may be the most user friendly database program in existence. This is the one that recognizes mispelld comandz. We're still wringing it out, but I like everything about it so far.

Finally, we have Koala Technologies' KoalaPad touchtablet for the IBM PC. I got to play with that at the Atlanta COMDEX, and I'm really looking forward to using it. The touchpad lets you add a whole bunch of new function keys to what you're doing or, alternatively, use it for finger painting. It'll be interesting to compare it to our Microsoft Mouse for the PC.

The game of the month for me has been Rogue; I've got to the twenty-first level with a saved game, and when I get back from NCC I'm going to see if I can't *win*. I also have a *compiled* version of Cygnus's Star Fleet I; compiling speeds it up wonderfully and removes many frustrations.

The clone of the month is still the Zenith Z-150, which does everything you'd want an IBM PC to do and does it just a bit more elegantly.

There are two recommended books this month. First, Richard Weiner and Richard Sincovec's excellent *Software Engineering with Modula-2 and Ada* (John Wiley and Sons, $24.95) examines both those languages, compares them, and looks at what is meant by software engineering. It's not for the casual user, but anyone interested in software trends will want it.

The second book of the month is *Fire in the Valley: The Making of the Personal Computer* (Osborne/McGraw-Hill, $9.95), a partial recount of what it was like in the early days of the computer revolution. Paul Freiberger and Michael Swaine have some details wrong, and they've left out some important players, but they've done a better job of capturing the flavor of Silicon Valley as it bloomed than any other book I've seen.

And, of course, there are boxes and boxes of stuff we'll get to Real Soon Now . . . ■

Jerry Pournelle welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE *Publications,* POB 372, Hancock, NH 03449. *Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply.*



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- RECORD LOCKING TO CONTROL MULTIPLE UPDATES

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MISCELLANEA

Dear Jerry,

A few notes regarding your May column.

Ahem, about your enthusiasm for the Sage, is it not a bit extreme to call it the best? Have you tried Charles River Data Systems' Universe, Microtechnology Unlimited's MTU140, or even HP's 9826? Calling the Sage the best 68000 machine among those you've personally evaluated would perhaps be more fair. I own a Sage and certainly prefer it to any other micro or mainframe I've had to deal with.

I too would encourage you to venture into FORTH and would suggest David McClain's HyperFORTH+ as the vehicle of choice. David is an astrophysicist who worked on the control system written in FORTH for the multiple-mirror telescope; he has authored an impressive system. HyperFORTH+ runs (screams) on the Sage, and if you are familiar with the UCSD p-System, it should be easy to learn. The user interface is similar to the p-System, and the text files and screen editor are compatible. It is a multitasking FORTH with many extensions suitable for real-time control. The documentation is quite good, and there is an on-line Help utility. Source code can be in one contiguous text file, and you do not have to hassle with screens of code.

David McClain was at the Sage Faire, and I saw a demo of his new HyperFORTH II that left me speechless. It looks like the programming environment of the future. It has a flexible syntax, allowing you to use the syntax of other high-level languages; there is a Lisa-type windows feature, a code profiler/optimizer, and many other goodies that were over my head.

It seems of late that your column leans a little too much in the software review direction and not enough in the direction of software techniques. How about hiring some more staff and breaking your column into two parts: a software review part and a software techniques part. We need the equivalent of a Circuit Cellar for software.

Anyway, I much enjoy your column. Keep up the crusade against obfuscating obscurantists.

PETER NORTON

You're right, of course: I should have qualified my statement. In my defense: I have several times spoken highly of the Charles River Data Systems machine; and the Charles River system costs quite a lot more than the Sage.

My son Alex is a Charles River Data Systems fan. I believe I've mentioned that.

For the past three weeks, Larry Niven and I have been grinding 8 hours a day on our novel Footfall; *when that's done, I intend to enjoy my Sage IV a lot more. I've always wanted to learn FORTH just to see what all the enthusiasm is about. On the other hand—the Modula-2 operating system will be running on the Sage about the time this is in print, and I'm very much looking forward to that.*

I used to do a lot more Software Circuit Cellar work, and once this novel is done I hope to get back to it. Thanks for the kind words. I like your stuff too.—Jerry

CP/M-86

Dear Jerry,

In the May User's Column, you discussed the CompuPro CP/M-8/16 system. I recently found that the Zenith implementation of CP/M-86 for the Z-100 computer also will automatically run 8-bit *.COM programs as well as the 16-bit *.CMD programs. This capability doesn't seem to be publicized, and I didn't even find it in the manual until after I accidentally discovered it. Naturally, there are a few restrictions, but they seem to be minor.

I haven't checked out this capability as thoroughly as you check your software, but everything that I have tried works fine. My requirements are considerably more modest than yours, but you might be interested in investigating this too.

LARRY HUDSON
Ventura, CA

Zorro, our Z-100, runs most CP/M 2.2 programs under CP/M-86 just fine; the Z-100 is indeed a good 8/16 machine. I think there are a couple of programs with fairly sophisticated BIOS calls that give it problems, but 95 percent of your 8-bit software will run under the 16-bit operating system. I believe I've mentioned this in previous columns.

I've no notion why Zenith doesn't advertise this 8/16 capability. The CP/M 2.2 programs that run under ZCP/M-86 run faster *and* better *because they have a large TPA (temporary program area) for workspace.*—Jerry

A SYSTEM THAT CAN TRAVEL

Dear Jerry,

I have a CompuPro 8088/8085 system with half a megabyte of RAM, a 20-megabyte hard disk, two 8-inch floppy-disk drives supporting four terminals, two printers, and a modem. It is running under MP/M-8/16. It works just fine looking after a small office environment. Although a bit slow when we are all on together, I know that I can upgrade it as new hardware and software become available. I like it. Not one hardware failure in 18 months!

I have a question that I am having difficulty finding an answer to. I believe that you have been there, and I am hoping that you will share your experiences with me.

I would like an additional system. It usually would reside at home but on occasions could travel with me on business. I would like it to be a portable system in the sense of the IBM or the Compaq. It would be a single-user system. As I am familiar with the MP/M-8/16 operating system, I would like to run the new system under CP/M-86 or CCP/M-86.

Such new systems use the IBM 5¼-inch disk format whereas the CompuPro I have uses the 8-inch IBM standard. I have not been able to find a suitable portable system that uses the 8-inch disk format.

I would like to be able to take 5¼-inch disks full of data files between the two. I am using WordStar, dBASE II, and SuperCalc, and I should like to be able to run these applications on both systems. I understand that I will require new versions of these programs, but I am hoping that there will be some way to interchange the data, other than using a modem.

Can I do it? Can I remove an 8-inch floppy-disk drive from the floppy-drive system and add an IBM-compatible

(continued)

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5¼-inch floppy instead, or even add a new 5¼-inch floppy-disk subsystem? Would the Disk I controller board in the CompuPro handle the different disk format? Would the BIOS in MP/M-8/16 "understand" it? Where can I start?

WILLIE FAHNESTOCK
Toronto, Ontario, Canada

I just got word that CompuPro's new Disk IA controller, which will run 5¼-inch drives as well as 8-inch ones, is available; Tony Pietsch's new BIOS was designed to work with it. I don't have my 5¼-inch drive installed yet, but I will very shortly—and with Tony's new Format program, I can read darned near any 5¼-inch disk format, including the Otrona, which I tend to take with me on trips.

The Otrona is very portable and an excellent Z80 machine. I'm not much impressed with the 8086 upgrade for it, but it does work. Eagle makes a fairly nice portable, but I don't really wish the documents on you.

I suspect it won't be long before darned near everything will run Concurrent CP/M and then you won't have a problem.—Jerry

LANGUAGE POPULARITY

Dear Jerry,

I respect your opinions regarding future developments, but I think you may be wrong concerning your C, Modula-2, and Ada prognosis. The micro business is so volatile that often the most accessible product becomes the standard, not the best. Of the three languages, I personally prefer Modula-2. It really is the best all-around language of the three for the micro world. Modula's problems, however, are numerous:

1. The best version requires the UCSD p-System and costs too much.
2. Licensing arrangements are prohibitive for the small entrepreneur.
3. Most versions are immature.
4. Even though the 8-bit world is waning in influence, there should be a CP/M version available.
5. It lacks a wide base of support.
6. It is not being promoted well.

Ada is too big and complicated to earn many fans in the microcomputer world. That leaves C, which is rapidly becoming the next new language. I think it may just become the most popular language for small systems. Just look at the ads. Many versions are available, support tools abound, and its supporters are many. If the past can be used to predict the future, C will be the preeminent language.

It is unfortunate that the main producers of Modula-2 are in effect contributing to their own lack of rapid growth. They have the best product but are unnecessarily restricting their product to limited growth. They need to reduce the prices of their products, produce native-code MS-DOS and CP/M versions, actively promote their products, and support growth by tearing up the dumb licensing agreements.

Languages become popular in the micro world because the hackers use them. Most hackers can't afford to purchase a poorly supported language implemented on a nonstandard operating system for a computer they don't own. Modula-2 producers need to wake up before C relegates them to also-rans.

ROBERT A. WILLIS JR.
Hampton, VA

I completely agree: the Modula-2 implementations we can get just at the moment do not do the language justice, and your complaints are well founded.

However, things are changing. A new Modula-2 compiler, complete with native-code compiler and Modula-2 operating system, is due to come out of England just about the time this is in print. Volition Systems continues to swear blind that a 68000 stand-alone native-code Modula-2 compiler is "just about finished." Logitech continues to work on the 8086 stand-alone—and if the company doesn't get it done pretty soon, Philippe Kahn of Borland has promised me his own Turbo 8086 stand-alone complete with integrated editor and all the other features we get with Turbo Pascal.

If we don't get good implementations of Modula-2, C may just win by default; which, in my view, would be a pity, because I have trouble remembering just what lines of C do—even if I wrote the lines.

Hang in there . . .—Jerry

VALDOCS

Dear Jerry,

I've enjoyed your incisive discussion of the Epson QX-10 over the months, but I've always harbored the suspicion you aren't as familiar with Valdocs as you claim to be, certainly not as you are with WordStar and some of the others. Which makes sense; using WordStar or PeachText requires some practice, while Valdocs does not.

But lo: In May's BYTE I find an actual, quantifiable "benchmark." In response to a letter praising Valdocs, you mutter, "it takes nearly a full minute simply to erase a single file under Valdocs . . ."

What?

Via Valdocs Index, I erased a 13-page, single-spaced document in 21 seconds. That's from writing screen back to writing screen. But then again, as a professional writer, I'm familiar with Valdocs.

So I pretended not to know Valdocs, and, wading through the menus, waiting for each to compose itself before selecting options, I erased copies of the same document in 31 seconds via Index and 34 seconds via Copydisk.

Anyone who requires "nearly a full minute" to erase a Valdocs file must spend half that time staring at the screen humming "dum dum dee dum dum" and wondering what's on tonight's *Mr. Rogers.*

How about some more QX-10 benchmarks from Pournelle?

PAUL BUNNING
Spokane, WA

With my Z80 CompuPro running WRITE under CP/M 2.2, I just saved a 23-page document in 7 seconds; erased all text in 2 seconds; and killed a file in 4 seconds. Killing additional files would take about 2 seconds each.

When I used Valdocs, I found my disk was full of back copies of the file because I save text often. Saving took forever; but killing those old dead files took time, too. If you say there's a way I could have erased the files in only 31 seconds I'll believe you—but that's quite a long time, you know.

With the version I had, it took a full minute, and I was actually watching The Pajama Game *on the late show.*

I'll do the new benchmarks on the QX-10 when Epson hands over the new and improved software it has sworn mighty oaths to provide.—Jerry

TOMCAT, ANYONE?

Dear Jerry,

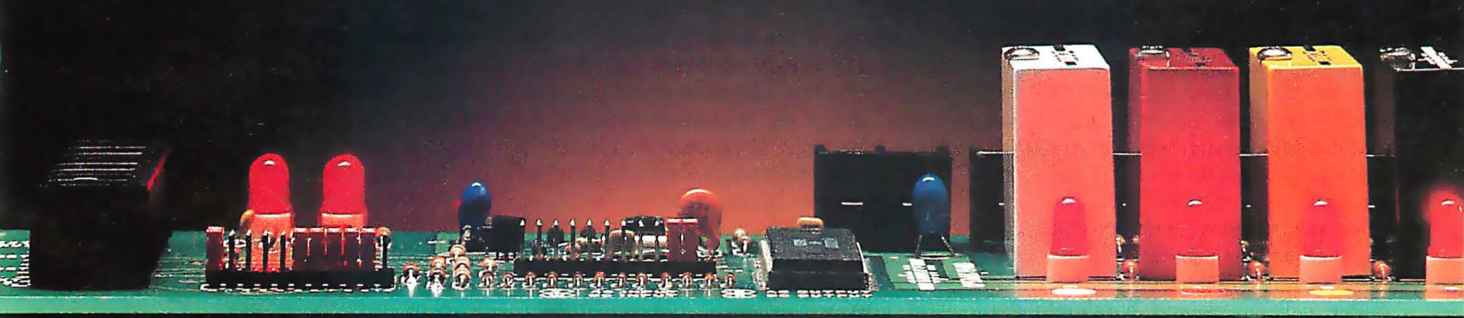
I purchased a PCX-1800 personal computer from Tomcat International Inc., Intersystem Group, Tokyo. Before I received the systems software and documentation, Tomcat went bankrupt. Now all I have is unusable hardware.

Can you help me make contact with the

(continued)

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representative of this firm in the U.S.? In case Tomcat is out of business for good, perhaps printing this letter would help me make contact with someone who purchased the same PC and has the software and documentation.

HUIBNER ALEKSANDAR
Ljube Stojanovica 22
11000 Beograd
Yugoslavia

Alas, I never heard of Tomcat International, and a quick check hasn't turned up anyone who has.

I'll ask them to include your address; perhaps someone with systems software and documents for your machine will make contact with you directly.

I don't go quite as far as my British columnist friend who advises his readers never to buy anything they haven't seen working in a store, but it certainly pays to be cautious, especially with international orders. Good luck.—Jerry

NAVIGATION AIDS

Dear Jerry,

Being a merchant seaman, I have plenty of time at sea to work on my new hobby (computers) but few resources other than the written word from which to learn.

In the March User to User, I was interested in "A Mariner Queries." Mr. Williams asked about the suitability of his Z-100 for use as a navigation tool aboard a cruising sailboat, and I feel you gave him a good and honest answer. There are a couple of comments I'd like to make, however.

I've been playing around with programmable calculators and hand-held computers, trying to figure out how best to apply them to navigation and other shipboard applications. We have been promised Z-100s by our office, and to borrow your phrase, "they'll be here Real Soon Now." Anyway, my basic conclusion is that for navigation the best implementation is with programs in ROM or in a computer with nonvolatile memory, such as my Sharp PC-1500. My point is this: navigation does involve working with numbers, but it is not very difficult, nor especially tedious. For a computer to contribute to easing the work load, it must be both easier and faster (not to mention that it also *must* be at least as accurate and reliable) as doing the same operation by hand. If I had to spend a minute or two starting up a computer, loading a program, etc. before I could begin, I think I'd be better off with a scientific calculator and a nautical almanac.

My conclusion, therefore, is that an ideal instrument for navigation would be a hand-held or lap-sized computer using CMOS technology and with the ability to maintain multiple programs in ROM or RAM. How much memory is required? I believe that 16K bytes of RAM is more than enough for even an elaborate navigation program. I have a fairly adequate program that does great circle and Mercator sailings, sight reductions, and azimuths and that is written in my own personal horrible BASIC code and fits in 1.8K bytes of standard PC-1500 RAM. With this type of implementation, it is a matter of picking up the computer, turning it on, and hitting one user-defined key to do what I need to do.

I've looked at the Radio Shack TRS-80 Model 100 and consider it to be suitable, but I think I'll be getting an HP 71B, mainly because it's smaller and can function as a calculator. A lot of navigation is improvisation and doesn't conform too well to the structure of a program! One last point: a printer is invaluable to peace of mind.

CHUCK BECKER
Sparks, NV

Captain, if you're an example of the Navy's computer neophytes, I don't think the nation has a lot to worry about. I've never done any blue-water navigation, but I have been led through the exercises: apparently there's a certain, uh, creative fudging done by the best.

On the other hand, sight reductions are a pain. I wonder why someone doesn't manufacture ROMs to turn one of the little CMOS machines into an instant navigation computer.

Of course, with a bit more work, all the almanac tables could be included on a disk or tape; but that would be a more complex machine. I always worry about moving parts in salt air—and everything in a small sailboat gets wet.—Jerry

POTPOURRI

Dear Jerry,

After reading your column for the past three years or so, I feel like making a few comments.

I noticed your recommendations for a computer for someone that does a great deal of writing. I recommend the combination that I am currently using. The computer is a Sanyo MBC-1250 CP/M machine. It uses two 640K-byte drives, a green screen that displays 80 columns by 34 lines, detached keyboard with 15 dedicated function keys, and the complete MicroPro software line. My printer is a Juki 6100 daisy-wheel printer that types at a reasonable speed of 18 cps. I purchased the entire system for $1995 at a computer store in Colorado Springs. I feel that this system is excellent for writing and for people looking for a business computer. It certainly is a major improvement over my old Apple II+ that I tried to make a business computer out of. I agree that almost any non-toy/game computer is a definite improvement over a typewriter.

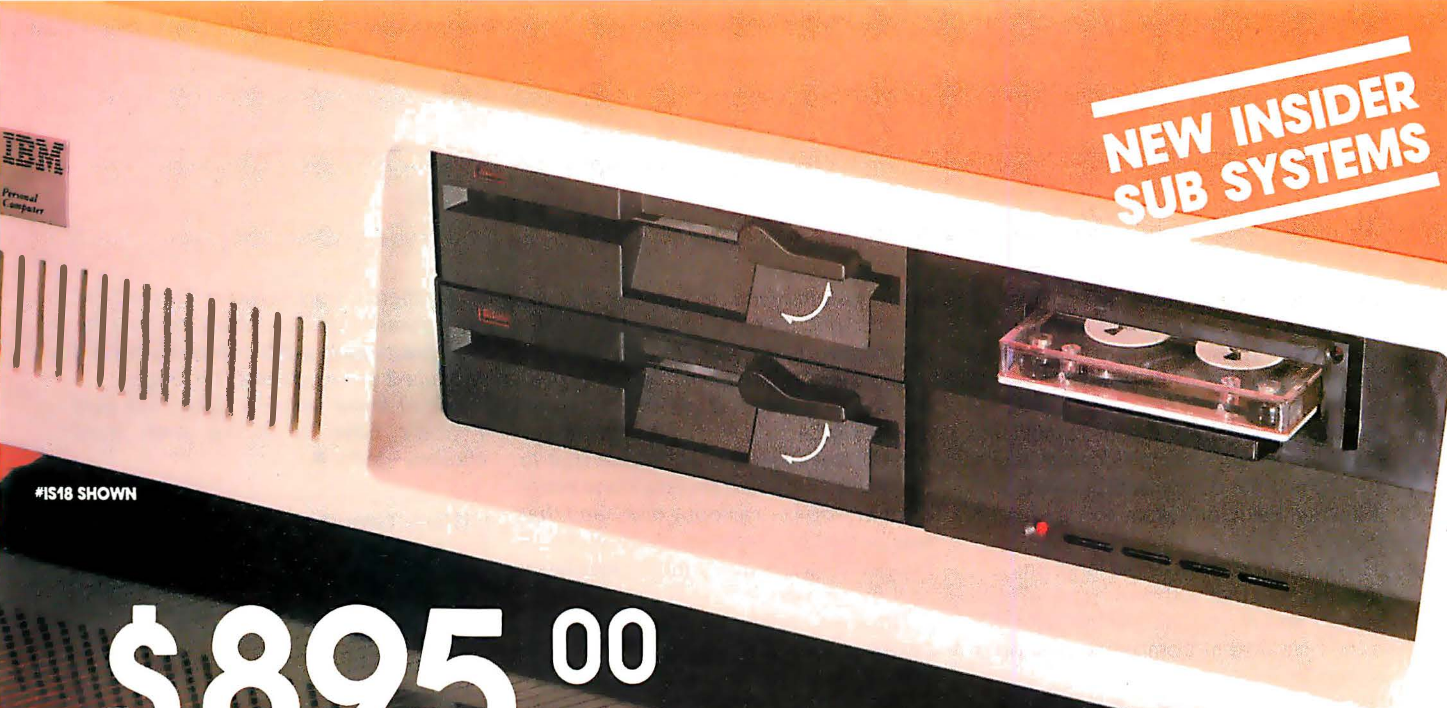
I would love to try WRITE, but I absolutely refuse to pay more than $100 for a program! I feel that the price of excellent books should equal that of excellent software. This is one of the reasons I bought a computer that had a large amount of software included, plus runs CP/M-80. I've sent for Borland's Turbo Pascal on your recommendation and may one day try Modula-2. Obviously, Borland feels that you can earn a decent living selling software for less than $100.

Congratulations on your victories in the software licensing contracts. I often wonder if lawyers ever took English I in college.

My main reason for writing is the S-100 bus. I have always wanted an S-100 system, but the high cost always seemed to be the negative deciding factor. Lately I have begun to feel that the S-100 is too costly for its own good. I felt rather justified when you acquired the Sage IV, and then I read the "Inside Track" column by John C. Dvorak, in the June 11, 1984 issue of *InfoWorld*. Mr. Dvorak pronounces, "The S-100 bus is dead." He gives these reasons for his decision: the magazine *S-100 Microsystems* changed its name to the *Journal for Advanced Microcomputing* and the high cost of the S-100 bus system. If it survives, "it will do so only as a ghost on the OEM level . . ." I don't know what background Mr. Dvorak has in the computer field, but some of the things he says ring the common-sense bell. Having the ability to change cards in the S-100 system really made sense when we saw the progress in microchip processors, memory boards, the advent of hard-disk systems with their special controllers, and I/O circuits, but I don't think that a home computer user really needs anything other than a Sage IV. As a matter of fact, a good Z80 machine might satisfy 90 percent of the home computer/small business users.

You have repeatedly mentioned that

(continued)



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S-100 systems require a good deal of knowledge to get going and that a lot of the CompuPro equipment you are using isn't bug free due to its new design. But it seems that every month you indicate that Tony Pietsch lives at your home! I find it very interesting reading to learn how you actually find the equipment problems with Tony, but I wouldn't want to pay for his visits.

In conclusion, think of the large amount of equipment that you own, especially the Sage IV, and do you still feel that the S-100 is the best system from a practical point of view?

Keep writing your excellent columns in BYTE and giving your honest opinion of computer hardware and software.

DONALD C. RUOKONEN
Elbert, CO

I wouldn't want to pay for Tony's visits either—but recall, Chaos Manor is a test site for new CompuPro systems and software. Sometimes I report the doings here; perhaps I shouldn't, if I'm giving the wrong impression. I have three CompuPro systems. One changes like dreams; we add to it, tear it apart, and generally reconfigure it.

Another, Zeke II, hasn't had the cover off in well over a year. The only maintenance I do is to clean the filter once in a while. He's so reliable that in two years I have had precisely one verify error in writing to a floppy disk—and that was probably a random piece of dirt. It happened while Larry Niven was here, and he smokes.

The third system is somewhere in between: it gets the latest stuff, but only after it has been checked out in other sites. I tend to work equipment pretty hard, so I'm an ideal one for finding potential bugs. That's what I usually report—but note that all these bugs are gone before you can buy a copy of the machine I have.

I give the S-100 bus another five years. Just last week Macrotech put in an 80286/Z80h microprocessor in my CompuPro system. Wow, is that fast! Try that with your other stuff.

As to CompuPro S-100 versus Sage IV: so far there's more software for the 8088 and upward chips; but about the time this is in print there will be some wonderful Modula-2 developments for Sage.

I don't know which is "best." I'm glad I don't have to make such hard choices.—Jerry ■

Users Group Corner

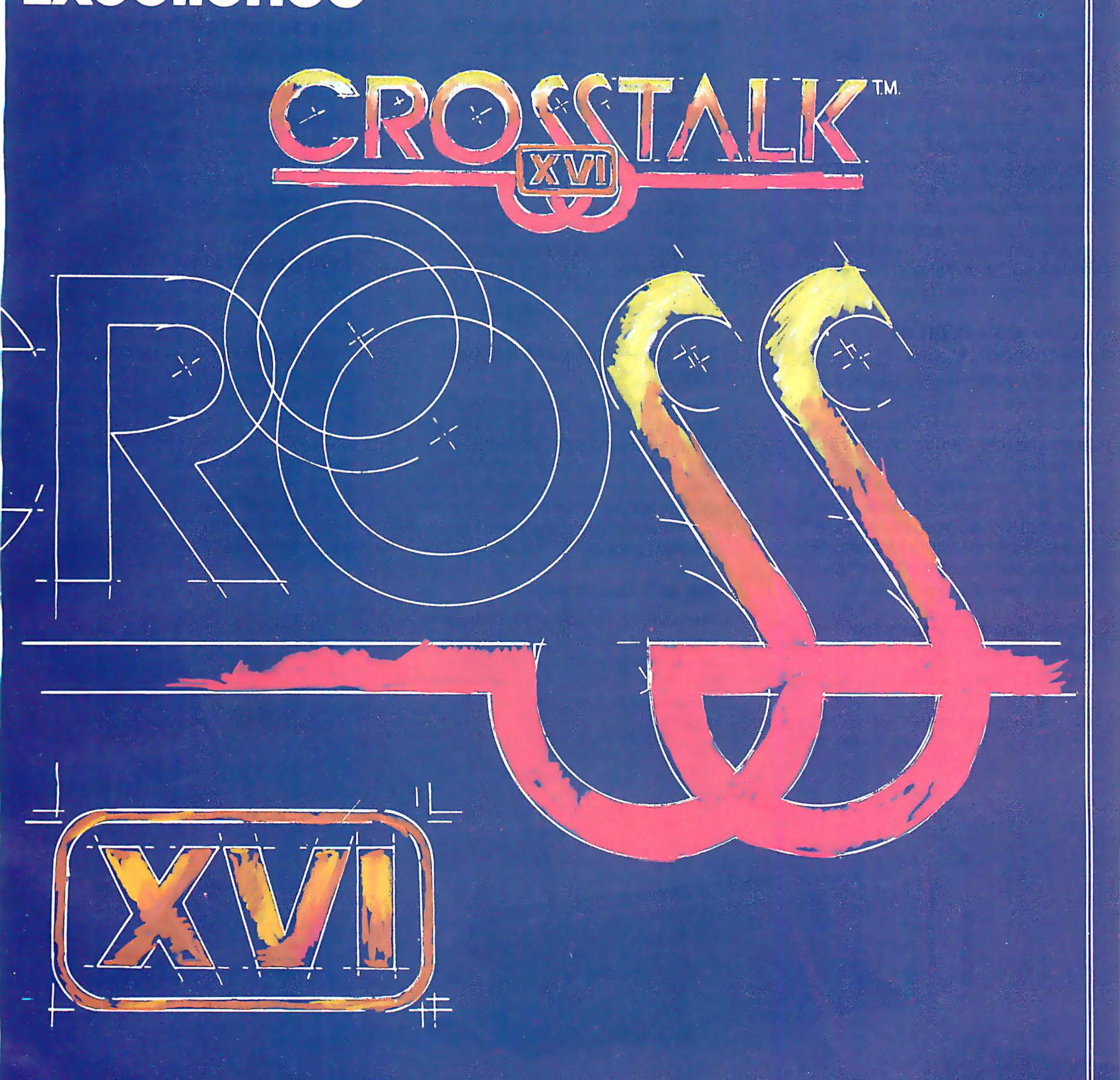
As a service, I'll try to include users group addresses in the future.

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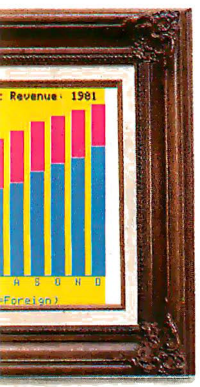


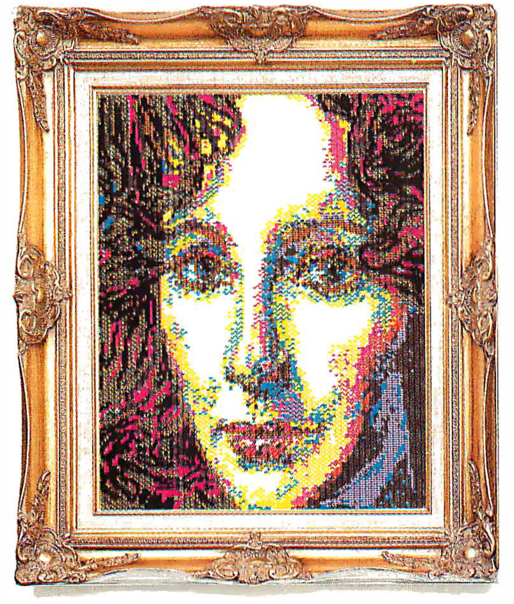
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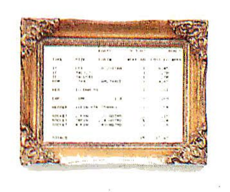


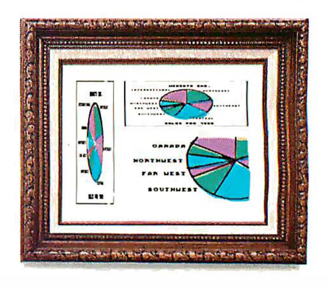
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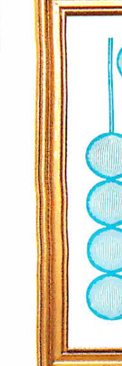
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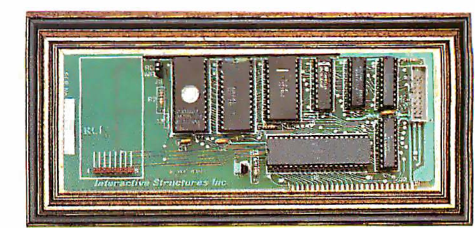
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FidoNet, Sidekick, Apple, Get Organized!, and Handle

Homebrew electronic mail, some integrated software, and other tidbits

BY JOHN MARKOFF AND EZRA SHAPIRO

Personal computer users have become accustomed to a wide variety of styles in electronic bulletin board systems (BBSs). Some are designed primarily for uploading and downloading software. Some are intended purely for conversations on topics of special interest. Almost all have been created and maintained—at no small cost in both time and money—by hobbyists intrigued with the potential of noncommercial computerized telecommunications.

As microcomputer software and hardware technology have evolved, BBSs have become both more widespread and more sophisticated. During recent years there even have been a number of experimental projects aimed at launching public-domain, multiuser, and networked BBSs. Though multiuser systems, by and large, have been successful (usually using spare processing time on larger computers), enthusiast networks and true electronic mail have not. They have remained the province of highly capitalized operations, including CompuServe, The Source, and MCI Mail. The cost of going on line with a nationwide mail system is prohibitive, at least if you start out with grandiose plans to maximize your coverage and your profit.

Today, the personal computer world's own Johnny Appleseed may be sowing communications networks instead of fruit trees. Tom Jennings, a system software designer for Phoenix Software, author of the public-domain Fido BBS software and system operator of the Fido electronic bulletin board in San Francisco, recently developed an additional program called FidoNet. (Jennings insists that Fido is not an acronym.) FidoNet is a utility that connects Fido BBSs for automatic message and file transfer; in other words, it's a low-cost public electronic mail service.

Jennings started the original Fido BBS in late 1983 as a hobby project. The idea was to make use of miscellaneous idle pieces of computer equipment. He never really expected that the software would spread or that he would become the founding father of a group of more than two dozen independent BBSs. But that's happened. Due to his own rethinking and constant queries from his family of operators, Jennings worked Fido through seven major revisions and countless minor overhauls and bug fixes.

Fido currently runs on several computers that support MS-DOS version 2.0 and higher, among them the IBM Personal Computer (PC), the Digital Equipment Corporation Rainbow, the Compaq, the Otrona Attache, and Jennings's own Multibus system. The program uses MS-DOS's capacity to segment groups of files into named directories. The segmenting trick has kept would-be hackers and system-crashers away from the guts of the program and gained Fido a reputation for being almost completely "bulletproof." Fido was written in Lattice (Microsoft) C. Jennings is the sole designer—he will not release the source code—and continues to modify the program based on input and support from users around the country.

"Fido wasn't designed," he notes, "it was just built."

After some weeks of bulletin-board discussion with other system operators, Jennings released FidoNet in June of 1984. As with Fido, the networking scheme has gone through constant improvement and fine-tuning.

Because FidoNet currently runs on single-task personal computers, it isn't yet a real-time network. FidoNet operates for only a short period each day; during the rest of the time, the regular Fido BBS software enables local and long-distance callers to upload and download files and receive and display messages. Then, for approximately one hour each day (late at night when the phone rates are low), FidoNet automatically activates itself, combines any messages marked as mail into packets, and transmits

(continued)

BYTE West Coast is prepared monthly by BYTE's editors and staff in San Francisco and Palo Alto. Correspondence should be addressed to BYTE West Coast, BYTE Magazine, 425 Battery St., San Francisco, CA 94111.

them to the other FidoNet members. Once the mail is received successfully, the Fido BBS returns.

The FidoNet transfer scheme is quite simple and ingenious, although probably not designed for many nodes. (Currently, FidoNet is functioning with approximately 35 systems.) At the start of the network hour, FidoNet creates its packets and places its calls. A simple collision-detection routine manages mail transfer. Each addressed node is called in turn until all packets are sent or until mail time is over. If an individual FidoNet fails to connect with another node, it continues to the next and repeats the failed attempt only after going through the rest of its list. In between each call, FidoNet waits for a random interval and checks for an incoming call. According to Jennings, this delay interval synchronizes the net after the first collisions. He says that after the first few minutes the process sorts itself out and almost no collisions occur.

If an incoming call is detected when the FidoNet station is in receive mode, the node attempts to connect. First, FidoNet determines the data-transmission rate and displays the message (to possible human callers looking for the BBS) that the system is taking calls only from other FidoNet nodes. Once a connection is established, packets are transferred to, and stored by, the receiving system for later distribution through the bulletin board.

After the specified network mail period, FidoNet erases all remaining outgoing packets (if there are any) and marks those that were sent successfully. Thus, the sender can tell if his message was transmitted.

One striking aspect of FidoNet is that Jennings has solved some of the communications-cost problems that previously confounded other system operators. The Fido BBS and FidoNet maintain cost records for each user as part of the regular BBS user log. If you want to use the system, you send cash, which the operator enters as a credit to your account. Every time you send a message, your account is debited by the appropriate amount. The software will not send a message if you don't have a positive balance. Like the commercial MCI Mail service, sending messages costs, but receiving them is free. The price of short messages is very low, frequently in the neighborhood of five cents each, and Jennings plans to lower the cost of FidoNet even more by adding data-compression algorithms.

Each FidoNet operator may limit access to the mail area of his Fido BBS and can separate access to "free" systems from access to systems requiring a toll call. This reduces bookkeeping headaches, yet lets the system operators (and users with permission) send mail to remote network nodes. Another feature designed specifically for system operators is a BROADCAST-message type mailed automatically to all the nodes in the system. Jennings also uses this feature to transmit updated versions of the Fido software.

Jennings continues to evolve the FidoNet software, and he hopes to support non-Fido BBSs (both MS-DOS and CP/M) as part of the network in the future. "I'll rewrite my code just to be compatible with the other guys," he says. Additional planned enhancements include forwarding and holding of messages, file attachment, and routing control.

Although he recognizes transcontinental mail as the glamorous part of the FidoNet service, Jennings maintains that its real effectiveness will be for regional networks. In fact, such a group is already developing around St. Louis, where there are four Fido systems. "I use the cross-country stuff to communicate with the other system operators," he says, "but I don't know who else really needs it at this stage."

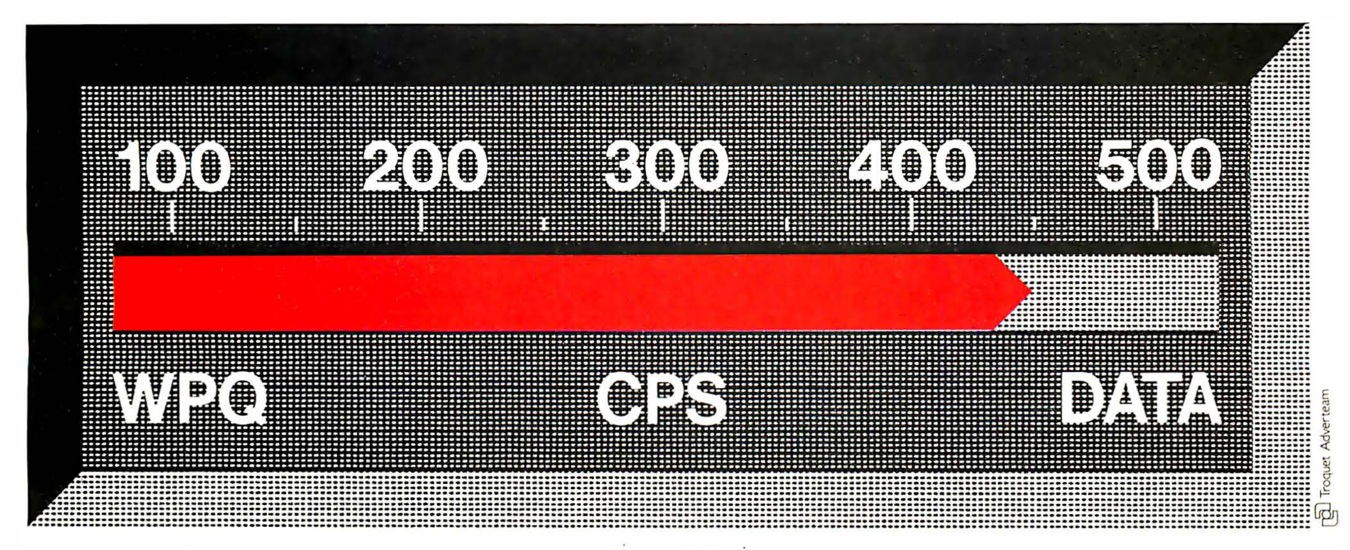
Whatever the future holds for an expanding FidoNet, this network is already a significant triumph for personal telecommunications.

Software Sidelight

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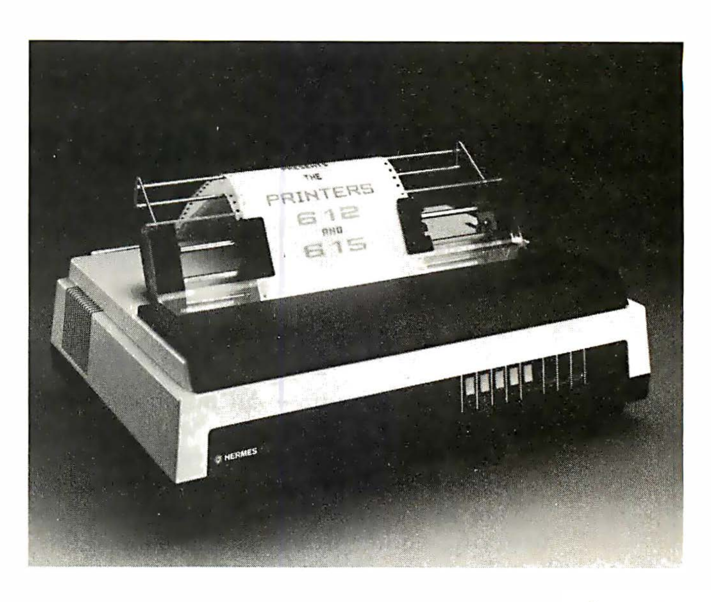
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support for the Intel 8087 math coprocessor chip), has introduced its first consumer software product, Sidekick ($49.95). It represents a novel approach to software integration for the IBM PC and compatibles.

In its full configuration, Sidekick includes a WordStar-like notepad text editor; a memory calculator that works in decimal, hexadecimal, or binary notation; a 200-year calendar and appointment book; a telephone dialer that sends phone numbers to any modem that accepts Hayes commands; and a table of the full 256 ASCII (American Standard Code for Information Interchange) characters used by the PC, which shows screen representation, decimal, hexadecimal, and control values. The distribution disk has four versions of the program with progressively fewer features. The smallest Sidekick contains only the calculator and the ASCII chart.

The trick to Sidekick is that you load it when you first turn on your computer and it remains resident in RAM (random-access read/write memory) until you reboot your machine. It chews up anywhere from around 22.5K bytes of memory (in the calculator/ASCII version) to a little more than 105K bytes in the full version when the notepad workspace is set up to handle a 50K-byte file. (The notepad can be set anywhere from 1K byte to 50K bytes.) Unless you're planning to use Sidekick for a major editing job—for which it is not designed—a reasonable workspace configuration should not cost you more than a single bank of RAM chips.

After you load Sidekick, you remain in DOS (disk operating system), and you can run any standard software. Pressing the Control and Alt keys simultaneously brings up Sidekick's main menu. A single-key mnemonic then starts any of the individual Sidekick applications. Because Sidekick stays in memory, you do not have to close down the major software you've been running. Sidekick takes control only as long as you need it, then it returns you to whatever you were doing before you interrupted yourself.

The Sidekick applications appear in colorful windows that can be dragged around the screen to convenient positions. The notepad can be sized anywhere from three lines by 40 characters to the full dimensions of the screen. A single status line across the bottom of the screen shows function keys and their results. All of Sidekick's windows can be displayed at the same time, though only one can be active. You can move from one window to another by pressing the Alt key plus the appropriate mnemonic. To get back to your main program, you can successively shut down each window or you can press Control-Alt again to exit Sidekick. The next time you invoke the program, the windows will reappear as you left them.

Though the notepad is not intended for heavy use (it contains no real text-formatting commands), it is more than adequate for creating and saving brief text files. It does have full cursor movement, deletion, insert/overwrite, block move, and search-and-replace capabilities. Two new features that will be welcomed by people familiar with WordStar include an Undelete command that brings back text as long as you're still on the same line and a stamping system that inserts date and time taken from the DOS clock. You can also collect text from the screen display (Sidekick lifts the characters from the computer's video memory) and manipulate it with the editor. Moving text from the notepad to the screen is not quite so easy; notepad material can be transferred only into a word processor's file by saving the notepad to disk and then using the word processor's commands to read in the disk file. The notepad works in straight ASCII characters, so it is possible to use it with almost any other software.

(continued)

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The phone dialer uses as its directory an ASCII text file that you've prepared with any editor. Using the display-collection ability of the notepad, you can scroll through any database or text document, lift a number from the screen, save it as a phone directory, and dial it with the dialer. The dialer is not a telecommunications program, however; it merely dials through a modem.

Both the notepad and the appointment calendar can direct output to a printer, as well as save files on disk. Help for all applications exists as a 41K-byte file that must be on your default disk.

According to Philippe Kahn, president of Borland, Sidekick was not developed as a commercial product. It originally was created simply as an in-house convenience to help with the day-to-day activities of a small software vendor. Programmers and salespeople wouldn't have to drop what they were doing to take notes or make phone calls; important projects could remain on the screen. It was only after several months of use that Borland realized it had a marketable product, he says.

The fact that Sidekick can be sold, however, seems to point out a major drawback in quite a few integrated software packages. Why should owners of advanced, multifunction business programs that are supposedly easy to use and that claim to solve all problems be compelled to purchase a utility like Sidekick? It makes you wonder about all those advertising claims.

Borland had originally intended to distribute Sidekick only as a copy-protected product, but a storm of public protest on CompuServe convinced Kahn to change company policy. If you purchase Sidekick for the list price of $49.95, you will receive the program on a copy-protected disk that must be used every time you load the program. However, if you sign a statement (included with the package) declaring your agreement not to distribute unauthorized copies of Sidekick and send that agreement (along with a check for $29.95) to Borland, you'll receive a second, unprotected disk that will enable you to make as many backup copies as you want. It's nice to know that there's still a software company that responds to its customers.

Companies Mentioned

Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(800) 538-9696;
in Canada, (800) 268-7796 or
(800) 268-7637

Borland International
4113 Scotts Valley Dr.
Scotts Valley, CA 95066
(800) 227-2400, ext. 953;
in California, (800) 772-2666, ext. 953

Electronic Arts
2755 Campus Dr.
San Mateo, CA 94403
(415) 571-7171

Fido BBS #1
2269 Market St., #118
San Francisco, CA 94114
(415) 864-1418 (by modem)

Handle Corp.
POB 7018
140 Mackinaw Rd.
Tahoe City, CA 95730
(916) 583-7283

Taxan Corp.
18005 Cortney Court
City of Industry, CA 91748
(818) 810-1291

Apple Watch

Lately one of the favorite sports here has been second-guessing Apple Computer. There is absolutely no end to the speculation about what Steve Jobs and Company are going to do to follow up on the successful Macintosh introduction. One thing is virtually certain, though: Apple has so much momentum it's not likely to rest on its laurels very long.

Beyond talk about the coming introduction of the 512K-byte "Fat Mac," the most frequently heard rumors mention a color-display Macintosh, a redesigned digital board for the Mac, and an internal half-height Winchester drive. However, with Motorola recently introducing the 68020 microprocessor (a full 32-bit version of the 68000-class processor with a 16-MHz clock speed), the Macintosh's hardware evolution seems assured. More interesting projects may be going on in the software realm.

Significantly, Alan Kay and Dan Ingalls, two of the key computer scientists involved in the development of Smalltalk at the Xerox Palo Alto Research Center (PARC), have recently started working for Apple. Kay is widely known for his thinking on the potential of personal computers, and Ingalls did much of the work in actually implementing different versions of Smalltalk at Xerox. They will join a number of other PARC alumni at Apple, including Larry Tesler, who was responsible for the Lisa's user-interface design.

Steve Jobs has said frequently and publicly that he intends to have Apple build a Dynabook, an idea first introduced by Kay. The Dynabook, as Kay sketches it, will be a powerful, portable, personal computer no larger than a book and will serve as a general-purpose information tool.

One rumor that fits well with the Dynabook scenario says that Apple recently talked with a manufacturer of flat-panel electroluminescent displays. Allegedly, Apple wanted to know if the company could supply 50,000 per month.

Entertaining Productivity

To paraphrase one great thinker, "Here in Silicon Valley, everybody always talks about the coming shakeout, but nobody ever does anything about it." In fact, it hasn't been a particularly good quarter for many software and hardware companies. Major publishing houses as diverse as MicroPro, VisiCorp, and Sorcim all have had bad news to offer recently. And manufacturers like Eagle, Corvus, Kaypro, Qume, and Fortune Systems have announced either losses or layoffs.

(continued)

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Thus, it might seem like a strange time for a publisher known for entertainment software to jump into the personal computer "productivity" market. However, that's exactly what Electronic Arts, San Mateo, California, has done. Until now, Electronic Arts was known for innovative packaging of computer games and for marketing efforts that portray software artists in the same way the music industry boosts rock stars.

The decision to move into business software doesn't really establish a new pattern. In getting into the low end of the market for microcomputer business programs, Electronic Arts is following in the footsteps of other game manufacturers, like Sierra Online and Broderbund Software, that have introduced inexpensive word processors for home computers. Electronic Arts already had a word processor in its line of products, and the company recently added a personal financial-decision program.

But Electronic Arts is taking things a step further. It is offering Get Organized!, an integrated software package for the IBM PC. It's designed to compete with more expensive integrated programs like Visi On, DesQ, Symphony, and Framework. One thing that sets Get Organized! apart from most of the crowd is that it is principally intended for those who work with words rather than those who work with numbers.

Get Organized! is priced at $199 and features seven different functions: word processing, telecommunications, appointment scheduling, database management, notepad, address book, and calculator. None of the individual applications modules can be called "high-end" programs, as they're all simple in design. But unlike other budget packages (for example, Software Publishing's PFS series), the applications all function together. For example, the address book works with the word processor to let you create custom letters. Also, it's possible to pull out the notepad and jot down a few notes while you're in the middle of any other program.

It will be intriguing to find out what kind of marketplace reception awaits Get Organized! In spite of the package's pretentious name, Electronic Arts is one of the first software publishers to target the low end of the IBM PC market with an integrated product. Everyone else (Lotus Development Corporation, Ashton-Tate, et al) seems to be going after what PR flacks call the "power user." Maybe Electronic Arts has a better idea in keeping it simple.



Photo 1: *Taxan's Model 305 tuner converts a color monitor into a television.*

UNIX Is Coming, UNIX Is Coming!

The Handle integrated software products, from the Handle Corporation, Tahoe City, California, are the first generally available microcomputer-like programs to run under AT&T's System 5 UNIX operating system. Initially, the software will run on the 3B2/300 and the 3B5, both rather expensive multiuser machines. Though nothing has been announced, if AT&T should start selling a UNIX subset for the 6300 personal computer or a similar machine, it seems a good bet that Handle will be there. In full configuration, Handle is a fully integrated seamless word-processing/spreadsheet/database/business-graphics conglomeration that uses a strip of blocks across the bottom of the screen to display current definitions of "soft" function keys. Rather than using a command entry area or control keys or full-screen menus, the user presses one function key, which produces a new display. This continues until you've done whatever you wanted. We haven't had actual hands-on time with the program, but it looks quite impressive on paper.

Handle indicated it has no plans to distribute the software itself. Ignoring traditional retail channels, the company intends to sell the program to OEMs (original equipment manufacturers) like AT&T; the OEMs will then decide how to sell the software.

Going the Other Way

Taxan Corporation has announced a new television tuner, Model 305 (see photo 1). It costs $129.95 and lets you convert a composite video computer monitor into a color television. Taxan claims that the higher quality of most monitor cathode-ray tubes will give you an amazingly sharp television picture. And all along we thought the idea of personal computers was to get us *away* from the vast wasteland. ■

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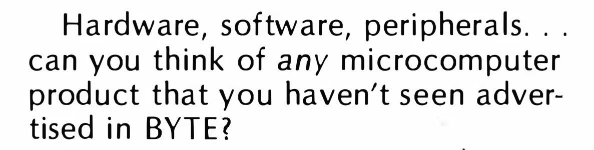


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B·Y·T·E J·A·P·A·N

Bits and Pieces

Hitachi CMOS 68000
Brother EP-44
Casio FP-6000
C quicksort

BY WILLIAM M. RAIKE

Knowing that I would write parts of this column in Tokyo and the rest during a two-week period while traveling in the U.S., I was strongly tempted to either buy or borrow a portable computer before starting the trip. Instead, I decided to purchase the latest EP-44 "portable printer" (an electronic typewriter with an RS-232C interface) from Brother. I'll say more about the EP-44 here, along with other bits and pieces from the computer scene including an excerpt from a recent interview with Casio about its FP-6000 computer system.

A CMOS 68000

The powerful 32-/16-bit MC68000 microprocessor from Motorola is soon to have a companion in the HD63000, a CMOS (complementary metal-oxide semiconductor) version that will be announced by Hitachi, probably later this year. Rumors have been circulating about a CMOS 68000 for some time; however, Hitachi would not confirm the HD63000 designation, saying only that the product was currently under development and that no details were available. But industry sources indicate that the new microprocessor, certain to have extremely low power consumption due to the CMOS technology employed, would be released in the same package size as the 68000, which comes in a 64-pin DIP (dual-inline package) configuration. The new chip is also expected to have a "flat-pack" version that will provide both cost and space advantages to designers who can incorporate it into compact, battery-powered equipment. The availability of an extremely low-power version of the 68000 is sure to boost interest in this microprocessor family, which, from at least some technical viewpoints, is superior to the more prevalent 8086/8088, particularly in the power and simplicity of its memory-addressing modes.

Meet My Brother

While lap-sized computers provide powerful word-processing features, being able to get an on-the-spot hard copy can be a real advantage. I wrote this column on my new Brother EP-44 electronic typewriter/serial printer, mostly in airline seats and at kitchen tables, and I like the machine more every day. (I printed the C program in listing 1 using the Brother as a serial printer connected to my computer and driven by WordStar.)

All of us who write (or type) for a living were impressed when the first Brother portable electronic typewriter appeared about a year and a half ago. But it produced 5 by 7 dot-matrix characters, and its convenience had to be weighed against the only marginally acceptable print quality.

The EP-44 is the latest in the EP series and has all of the word-processing capabilities necessary for on-the-go writing needs; its 3725 characters of RAM (random-access read/write memory) storage provide a reasonable ability to store short documents or boilerplate paragraphs, and the print quality is outstanding. Operating as a 24 by 18 dot-matrix thermal printer at 16 characters per second, it puts most letter-quality impact printers to shame. To top it all (and the feature that explains Brother's "personal printer" slogan), it has a built-in RS-232C interface. I paid the equivalent of about $225 in one of the stalls near the Akihabara electronics bazaar in Tokyo. That makes it the least expensive letter-quality printer in town, besides being a useful full-duplex hard-copy terminal.

Using the EP-44 as a typewriter is simple and natural. The keyboard is full-sized, with Shift, Shift Lock, Backspace, Carriage Return, Tab, and Margin Release keys in their conventional positions. The keys are square, with a firm, single-stage action and good key feel. The F and J keys have little bumps on the keycaps to provide tactile confirmation that your fingers are in the home position. Almost no noise comes from the keyboard; in fact, one of the most

(continued)

William M. Raike, who holds a Ph.D. in applied mathematics from Northwestern University, has taught operations research and computer science in Austin, Texas, and Monterey, California. He holds a patent on a voice scrambler and was formerly an officer of Cryptext Corporation in the United States. In 1980, he went to Japan looking for 64K-bit RAMs. He has been there ever since as a technical translator and a software developer.

noticeable features of the EP-44, commented on by nearly everyone, is its silent operation, a result of the thermal (rather than impact) printing method. A fringe benefit is that, if desired, you can type or print on thermal paper and eliminate the need for a ribbon cassette. With either the ribbon or thermal paper, the print is dense black, with 10-pitch characters that show clear serifs and no visible spacing between dots.

An alternate Shift key, located at the left of the keyboard together with the left and right Margin Setting keys and the Tab Set and Tab Clear keys, provides a third character associated with each key. The resulting character set includes various special symbols and letters from foreign alphabets, so that you can type in French, Spanish, German, or Swedish. The space bar, Backspace, and Carriage Return are autorepeat keys, and a separate Repeat key enables any key to be repeated automatically.

A blue "Code" key, analogous to a control key, located just to the left of the space bar gives you access to some of the electronic-typewriter functions of the EP-44, such as automatic centering, automatic underlining, flush-right margins (right justification), and automatic return and typeahead at the end of a line. You can enter, insert, delete, and modify text within the character memory using Code key functions, and you can display the amount of memory remaining.

The 15-character LCD (liquid-crystal display) panel just above the keyboard enables you (when using the EP-44 in CP [correction print] mode) to correct, insert, and delete text in the 15 most recently typed characters. As new characters enter the display on the right, the display shifts left and the leftmost characters are printed on the page. You can bypass this feature in the DP (direct print) mode, in which characters are printed as soon as they are typed. A no-print mode, in which characters can be entered into memory but not printed, is also available. You can insert text on either a character-by-character or line-by-line basis by positioning a cursor. The display also indicates the status of the various electronic-typewriter functions (flush-right margin, underlining, etc.) and the battery level.

Major text modifications are accompanied by yes/no prompts and queries on the display, preventing you from unintentionally destroying text or spoiling pages.

Another feature, both interesting and useful, is that the display is also used for the built-in calculator. After you complete a calculation, you can delete unwanted decimal places just by backspacing over them, which lets you select the number of significant digits to be printed on the page.

The EP-44 can become a full-duplex terminal or a remote serial printer when a cable is used to connect the RS-232C connector on the right side of the machine either to a modem or to a computer with an RS-232C interface. A Mode Selection key selects a transmission rate between 75 and 1200 bits per second (bps), any desired parity, and any of the three built-in character sets. Transmission and reception use an 8-bit format, plus one start and one stop bit, and the simple XON/XOFF protocol. I created a reinstalled version of WordStar on my computer to drive the EP-44 in less than 10 minutes.

Normally, the EP-44 runs on batteries (four D cells), but a receptacle on the back means you can use a 12-volt DC adapter if desired. Another feature is an on-board backup battery that gives you about one hour to change the batteries without losing any stored text. With batteries, the EP-44's total weight is only 5.5 pounds.

The ribbon cassettes cost a little over $2 each and last for about

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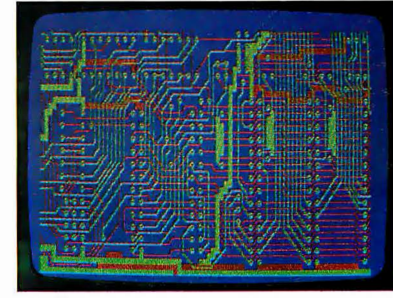
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CASIO FP-6000

Casio perhaps is best known for pocket calculators and electronic watches, but its FP-1000/1100 family of 8-bit Z80-based personal computers, introduced last year, showed that Casio was prepared for a serious entry into the personal computer field. When Casio announced the 16-bit FP-6000 computer system, I looked forward with considerable interest to seeing what this next step would be. The answer was that the FP-6000 is based on the 16-/16-bit 8086 microprocessor, running at 8 MHz and supplied with 256K bytes of standard RAM, expandable to 768K bytes. Floppy-disk drives are only available in a separate unit; the same is true for RS-232C and 10-megabyte hard-disk interface boards.

The price for this rather ordinary system, including two 5¼-inch 320K-byte disk drives and a 12-inch display, is over $2800, a good 50 percent above other 16-bit computers in its class, some offering substantially more features. Further, the system comes with MS-DOS and C_{86}-BASIC as the only software, except for a floppy-disk format conversion utility; no applications software is included in the purchase price.

The following excerpt from a recent interview with Tadashi Sensu, manager of the System Equipment Marketing Division of Casio, reflects some of the differences in marketing viewpoints in Japan and provides some perspective on the future of the personal computer industry.

BYTE: What are your plans for marketing the FP-6000 outside Japan?
SENSU: We will market the FP-6000 in Europe, in over 15 countries, but not in the United States.
BYTE: What do you see as the chief marketing problems in the U.S.?
SENSU: In view of the limited production quantities possible for the FP-6000 and of the needs of U.S. users, we feel that the price and the limited software availability for the FP-6000 would result in a cost-performance ratio that would make it difficult for us to effectively market the FP-6000 in the U.S. Also, IBM has adopted an aggressive strategy; our technological capability is high, but legal factors make it virtually impossible to fight the IBM clones. To do that, it would be necessary to come in at a price 40 percent below IBM.
BYTE: Why so little software?
SENSU: Actually, a great deal of MS-DOS software is available through cooperating vendors, but not through Casio directly. You must understand that while there are about 500 software firms in Japan, there are over



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5000 in the U.S. Also, there are different buying habits in the U.S. and Japan. Americans choose the software they need, then buy a machine to run it; Japanese select the hardware vendor, then purchase software. As a result, most software and hardware manufacturers develop their products separately in the U.S., while in Japan software is often developed together with the hardware manufacturer.

Never Out of Sorts

Numerous versions of the quicksort algorithm exist; in fact, the quicksort seems to have become a de facto standard as one benchmark for comparing C compilers. The C language quicksort that appeared in two BYTE articles by Christopher Kern ("Five C Compilers for CP/M-80," August 1983, page 110, and "Another Look at CP/M-80 C Compilers," June 1984, page 303) is compact and easy to understand and measures how well any given C compiler handles pointers. It doesn't provide a particularly efficient sorting algorithm, though, for sets of data that already are sorted (or nearly sorted) in either the correct or reverse order, which is often the case when you add new data to previously sorted records.

A couple of simple modifications, involving principles that are old hat to some but that are bound to be new to others, can dramatically improve the speed and efficiency of the quicksort (see listing 1).

(continued)

Listing 1: *Modified quicksort algorithm in C uses center pivot to enhance speed in already sorted or nearly sorted data.*

```
/* Quicksort */
quick(lo, hi, base) /* Sort strings pointed to by base[lo] . . . base[hi] */
int lo, hi;         /* into increasing order */
char *base [ ];
{
        int     i, j, piv;
        char    *pivot;

        if (lo < hi) {
                piv = (lo + hi)/2; /* Select center pivot. */
                i = lo; j = hi; pivot = base[piv];
                while (i < j) {
                        while (i < j && strcmp(base[i], pivot) < = 0)
                                i++;
                        while (j < i && strcmp(base[j], pivot) > = 0)
                                j--;
                        if (i < j) {
                                swap(&base[i],&base[j] );
                        }
                }
                if (piv < i && strcmp(base[i],pivot) > 0) i--;
                swap(&base[i],&base[piv] );     /* Put pivot element in */
                                                /* correct "middle" position */
                if (i - lo < = hi - i) {
                        quick(lo, i - 1, base);
                        quick(i + 1, hi, base);
                }                               /* Do shortest subset first */
                else {
                        quick(i + 1, hi, base);
                        quick(lo, i - 1, base);
                }
        }
}
swap(x,y) /* Swap a pair of pointers */
char *x[ ], *y[ ];
{       char *temp; temp = *x; *x = *y; *y = temp;}
#include stdlib.c
```

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The critical feature is the way in which the pivot element is chosen.

The basic idea behind quicksort is to select one of the data elements as a "pivot" and then swap pairs of elements that "bracket" the pivot in order to end up with all elements that are less than the pivot to the left of the pivot and all elements greater than the pivot to the right. This sort divides the original data into two subsets; the same procedure is then applied (recursively) to each of the subsets until only one element remains in each subset. Of course, it is much faster to swap *pointers* than actual data elements.

The critical feature is the way in which the pivot element is chosen. Instead of selecting the "rightmost" element (the one with the highest subscript), the version in listing 1 selects the "middle" element. If you sort a few small examples using pencil and paper, you will see why this version works better on nearly sorted data or on data that starts out in reverse order.

There are lots of other, more complicated, possible pivot-selection rules, such as pivoting on the median value. The advantage of the "center-pivot" rule shown here is that it requires little additional computation to select the pivot.

Finally, the if. . .else statement at the end of the program allows the shorter of the two subsets to be handled first. Doing one before the other has essentially no effect on speed, but it limits the maximum length of the stack (the "depth" of the recursion) to $\log_2 n$, where n is the number of items being sorted. Even for n = 32,768 items, for example, the stack never gets deeper than 15 levels. Without limiting the stack length, the stack could reach a depth of n, potentially clobbering both program and data.

This routine was compiled using the Software Toolworks C/80 compiler; the #include STDLIB.C on the last line directs the compiler to include the file containing the standard library functions like strcmp(), which are provided with C/80.

Coming Up

Next month, BYTE Japan will feature the NEC personal computers sold in Japan, plus a look at the Vectorio III, an Apple-compatible portable. You'll also find a C program that allows you to simulate "pipes," UNIX-style, and multiple-command lines under CP/M. ■

Thinking of buying a modem? You owe it to yourself to check out the Qubie' 212A modems.

Inside Outside

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In September of 1983 we introduced the first 212A modem card for the IBM PC available for under $300. The PC212A/1200 is a complete communications package including PC-TALK III software, modular phone cable, card edge guide, and instruction manual. The modem is an auto-dial, auto-answer type, which uses all the Hayes software commands so it can be used with any of the popular software packages including Crosstalk,™ and Smartcom.™ We picked the best software package we could find based on it's ease of use and features, PC-TALK III. Our modem includes features the old industry standard missed out on. Like being able to fit in one slot in a Portable PC or PC/XT. Or an optional connector to use the modem's serial port when not using the modem. Of course the topper is the $299 price, hundreds less than the competition.

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It's attractive gold anodized case houses seven status lights (who says low prices means a shortage of features). It fits comfortably under a standard telephone. It is also a 212A compatible auto-dial, auto-answer modem which supports all Hayes software commands. Even the switch settings are the same, so any software giving recommended switch settings for a Hayes modem can be used, without knowing what the switches do. There is a volume control knob for easy adjustment of the speaker's output. Included in the package is modular phone cable, a cable to hook it to your computer or terminal, and instruction manual. Choose the communications package right for your needs, and you're ready to go!

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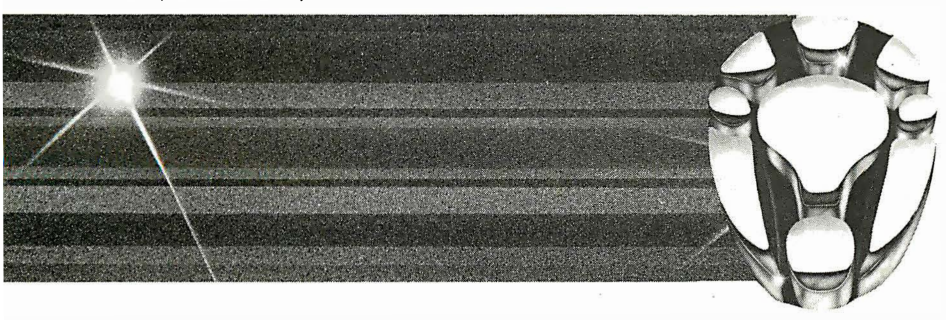
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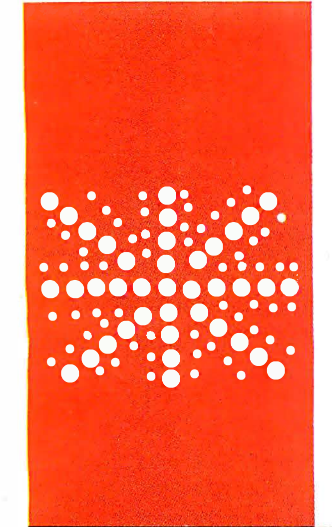


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POP *and* SNAP

Another AI language family

BY DICK POUNTAIN

If it's true that the world is an electronic global village, I find it rather strange that national and regional differences still persist within the computing community, the supposed vanguard of the revolution. Nowhere are these differences more pronounced than in artificial intelligence (AI) research, which surely is the vanguard of the vanguard.

The best-known example of such a difference is the LISP/Prolog divide. By and large, American AI researchers are committed to LISP, whereas Europeans favor Prolog. Because LISP was invented in America at the Massachusetts Institute of Technology, while Prolog was developed in France, Hungary, and the U.K., the academic debates often contain a nationalist undercurrent that is less than useful. The recent adoption of Prolog by the Japanese Fifth-Generation workers only adds to the emotional charge.

However, reality is rather more complicated than rumor. While Prolog is certainly popular on European campuses, it is not the only tool used by AI researchers in the U.K. A variety of experimental languages are in use at different centers (especially functional languages), but one particular language family has been established long enough to qualify as a third option.

POP

POP-2 was developed at Edinburgh University (by Burstall, Collins, and Popplestone) in the late 1960s as an alternative to LISP. While POP does all the same things LISP does—it's a list-processing language in which all data objects are in the end represented as lists—it's far easier for nonspecialists to learn because it uses a more conventional, procedural syntax. POP programs look rather like Pascal and are much more readable than their LISP equivalents. Before I start to receive letterbombs by transatlantic mail, I should add that this is not meant to disparage the economy and elegance of LISP syntax, nor to devalue its historical influence—without LISP there could have been no POP or Prolog.

POP was taken a step further at Sussex University (by Clowes, Sloman, Hardy, and others), where it became a powerful integrated programming environment called POP-11. POP-11 includes a full-screen, syntax-checking editor and a variety of debugging tools that are probably unrivaled anywhere outside of Smalltalk. Also, the emphasis has subtly shifted. Though POP-11 is an excellent tool for AI research, the Sussex workers decided that it also would be fine for teaching novices to program, and this has been tested in a few selected English schools.

The argument runs that novices need powerful rather than puny systems on which to learn. The best analogy is not the automobile (where you wouldn't dream of turning a learner loose in an AC Cobra), but music; you'll find it much easier to learn on a fine instrument than a creaky old wreck.

Dr. Aaron Sloman, one of the developers of POP-11 (in a research paper, *Why Beginners Need Powerful Systems*, 1982—see "For More Information" on page 388) lists 25 features he considers essential in a good teaching language. I don't have space to catalog them here, but I'll mention a few.

First, the environment is as important as the language. BASIC still is the most popular language despite its shortcomings because the integrated editor environment it provides is so much friendlier than a compiler/editor/linker/loader setup. All operating-system functions and debugging and tracing aids should be available without leaving the system.

This leads naturally to an interpreter or incremental compiler (as in FORTH) as the preferred choice. General-purpose data structures are necessary, but strong typing is not. You need lists as well as variables and arrays, and they should all be able to hold data of any type as in LISP, Logo, and Prolog.

(continued)

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Procedures should be objects that can be stored in variables, passed as parameters, and generated by other procedures.

Memory allocation should be handled automatically and be transparent to the user. Because we're using lists, this means efficient automatic garbage collection.

Users must be able to interrupt and suspend program execution and do anything that the language allows, including defining new procedures and editing existing ones, during the break.

Error trapping should be user-definable and dynamically alterable, so that different levels of error reporting can be provided for different levels of student skill.

Finally, graphics are essential, preferably in an easy-to-program form as in Logo.

None of this comes cheaply—POP-11 at the moment runs only on the Digital Equipment Corporation (DEC) VAX and some other large UNIX systems. In fact, the latest development is an even larger system called POPLOG, which brings together POP-11, Prolog, and LISP in a common, incrementally compiled environment; programs compiled from Pascal, FORTRAN, or C can be linked in as well, which covers just about all the bases.

SNAP

The story does not end here for personal computer users. A group from the Social Psychology department at Sheffield University is in the process of implementing a language called SNAP, based on POP, for MS-DOS systems (including the IBM Personal Computer) running in 128K bytes of memory. SNAP is not a full implementation of POP-11, but it includes many of its important features and even improves on it in some areas. SNAP already is running on the department's Onyx (UNIX) system, and this is the version that I've tried out—the conversion to MS-DOS is on target for a preliminary version to come out in October of this year.

The reason that psychologists became involved in writing a programming language is simple; they need to use computers in their experimental work and have become dissatisfied with the available languages. They find themselves continually facing the "4:30 Friday" problem—how to get medium-sized but complex programs up and running in a short time. The programs tend to be cognitive psychology experiments that require symbol processing and sophisticated screen handling.

In a typical experiment, random English sentences might be generated and displayed fleetingly, one word at a time, with an adjustable real-time delay. Microcomputer LISPS don't have the screen-handling capability, while Pascal and C are hampered by the slow edit/compile/link/load cycle. BASIC just isn't powerful enough. SNAP fills the vacancy and has the added benefit of being easy for noncomputer specialists to learn and use. The intention is that SNAP should be sufficiently general purpose to handle all a lab's programming chores, from experiments and simulations through data capture and statistical analysis to instrument control and graphical output.

In case you run away with the idea that anyone can implement POP, note that two of the team (T. Green and A. Arblaster) are specialists in the psychology of computer use, one (A. Cornah) is a computer scientist, and another (T. McClusky) is a professional programmer.

Using SNAP feels much like using BASIC, LISP, or FORTH. You type in commands and they are executed immediately, or you can type in definitions to add new commands—they are compiled on the spot into a dictionary, more like FORTH than BASIC.

SNAP doesn't at present have a built-in editor. The development is being done under UNIX, which lets you call an external editor (Mark of the Unicorn's Mince) from inside the system. Since MS-DOS lacks this multitasking ability, a Tiny Editor is being developed to reside in the system.

The syntax of SNAP resembles a less-fussy Pascal with overtures to C (it's written in C). Like most noncomputer scientists, the authors hate typing, so keywords tend to be terse.

The overall structure of programs is similar to that of LISP. Function definitions cannot be nested and they stand alone, without any need for a program body or main function as in Pascal and C. There is no necessary order to function definitions, and one function definition can include a call to another that is not yet defined, as long as it gets defined before run time. You can run any function merely by typing its name. As an example, the factorial function could be defined as shown in listing 1.

The edef and eif mark the end of each control structure, formed by adding e (for end) to its name.

SNAP Functions

Functions return their values on a stack, so to use the function you type print(factorial(5)), or factorial(5) **=>**, both of which print the stack top value 120. The optional giving 1 specifies that exactly one value will be returned. If used, it causes a compile-time check that the definition actually does return the right number of results and thus alleviates the explosive effects of stack errors with which FORTH programmers are familiar.

Functions can return as many (or no) results as desired. Real as well as integer arithmetic is provided, and the system is equally happy with infix, prefix, or reverse Polish notation.

An alternative nonrecursive factorial function that includes some more features is shown in listing 2.

Locals declares the two variables to be local to the definition; if declared outside the definition by vars, they would become global. The scope of variables is lexical (i.e., fixed by the program text at compile time) as in Pascal. The assignment operator **->** is immensely flexible because you can assign any kind of object (number, string, array, list, or function) to any name.

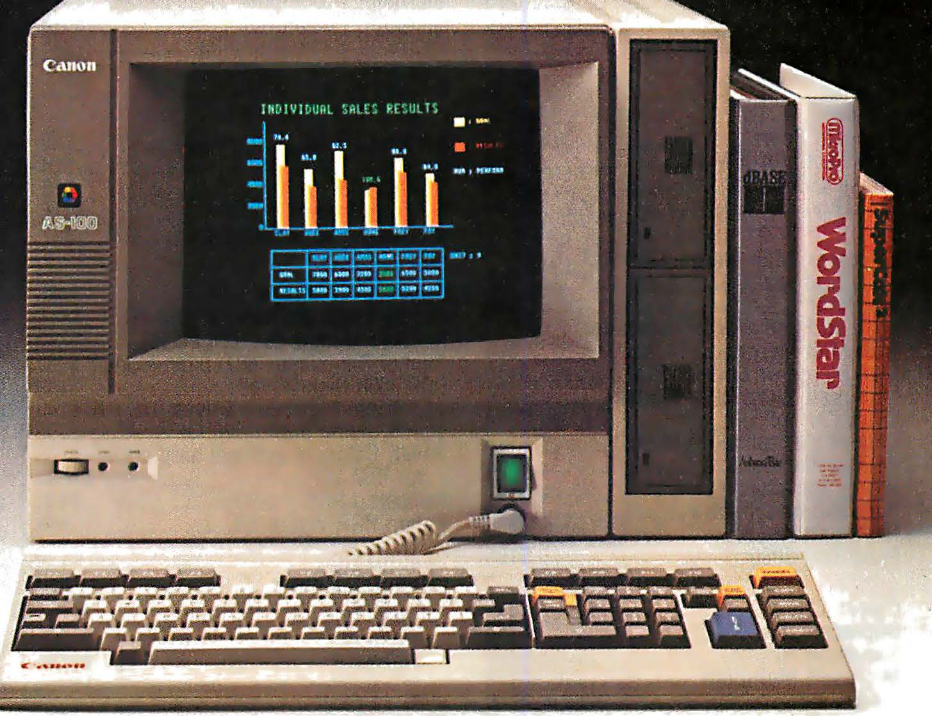
You also can alter the system by assigning a new function to one of the system functions. In this case, the

(continued)



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operator nonop is required. Nonop stops a function being evaluated and returns it as an object (also required for arrays but not for variables or lists); e.g., nonop newprompt -> nonop prompt.

Such latitude offers the powerful possibility of storing functions in an array (maybe dynamically during a program run), where they can be executed by obey as in obey (funarray(23)).

This flexibility is typical of SNAP. Take another example. The ASCII (American Standard Code for Information Interchange) characters are divided up into classes (letters, numbers, symbols, control characters, separators, white space, quotation marks) and the class of any character can be found by the function charclass. If in a particular application it's convenient to change the class of a character, say, to allow \ to be used in identifiers, all you do is assign the class of any letter (for example, a to \). SNAP uses this class system when lexically analyzing input text; for input purposes, a word ends whenever the class of the characters changes, so A+B without any spaces will be read in as three separate words. In a similar way, all infix operators have a precedence property that can be assigned to set the precedence of user-defined operators.

(continued)

Listing 1: *A sample factorial function.*

```
def factorial (number); giving 1
  if number = 1 then 1
  else number * factorial (number-1) eif
edef
```

Listing 2: *A nonrecursive factorial function.*

```
def factorial (num); giving 1
locals j p
        1 -> p
        for 2 to num -> j do
              p * j -> p
        edo
        p
edef
```

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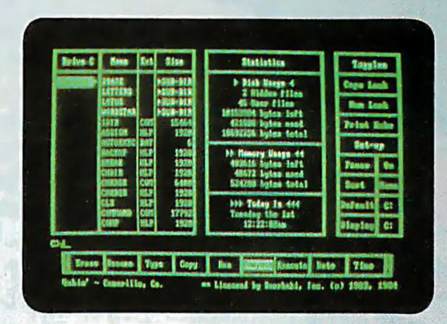
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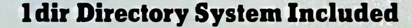


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File I/O (input/output) is performed by redirecting the print and read functions to a named device or file. It's also easy to redirect I/O to data objects inside the system by assigning them to the system variables sink and source.

SNAP accommodates arrays of up to five dimensions, and you must set both the upper and lower bounds when they are declared (an inheritance from Algol). For example:

```
array([1,10,1,20]) -> x
```

makes x a 10 by 20, two-dimensional array with lower bounds of 1. You can use variables or expressions in the declaration to give dynamically variable size and dimensionality. And the functions ndims, ubo, and lbo (upper bound and lower bound) enable a receiving function to find out what sort of array it has been passed. Arrays can hold any mixture of any sort of object, so it's possible to use them like Pascal records or to do things like pass a variably sized array of mixed functions and data as a parameter.

SNAP has a full set of string functions cribbed directly from BASIC (a nice recognition that BASIC has *some* good elements); len, mid, left, right, and instr work just like their $ counterparts.

Lists are handled as in LISP but are contained in square rather than round brackets—e.g., ["A" x [1 2 3]]. One level of evaluation takes place unless quotation marks are placed, as around A, and a whole list can be quoted by using curly brackets, as in {a b c 1 2 3}.

The functions to manipulate lists are hd (head), tl (tail), and cons (construct), supplemented by first, second, third, fourth, nth, and last to return the specified elements in a single step. The head, tail, and construct functions are equivalent to the CAR, CDR, and CONS functions in LISP. CAR returns the first element in a list, CDR eliminates the first element, and CONS builds a new list structure.

Among the many built-in predicates (or tests) is islist to test for listhood; islist is unLISPlike in that it returns

(continued)

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To summarize, SNAP *combines the best of* BASIC, LISP, *and* FORTH *with the readability of* Pascal.

FALSE when a list becomes empty, which is more convenient for controlling iterative loops. As a sample of how list processing is done, listing 3 shows the definition of a function that applies any function to each element of a list (like MAPCAR in LISP) and returns a single list of its results.

Listing 3: A *sample apply-to-all definition.*

```
def apply-to-all (function list); giving 1
        [
        while islist(list) do
              function(hd(list))
              tl(list) -> list
        ewhile
        ]
edef
```

Perhaps the most powerful built-in feature of POP-11 is its pattern matcher. SNAP has such a matcher, but it comes as a library function and it is somewhat less powerful. The POP pattern matcher can assign values to variables:

[Fred Brown lives in Liverpool]
-> [??x lives in ?y]

leaves x having the value Fred Brown and y having the value Liverpool. The ? means take any one item, ?? means any number of items, and the -> operator will give an error if a match is not found. An alternative operator, matches, returns TRUE or FALSE depending on whether the match succeeds. You can make this process even more powerful by placing functions after the match variables to restrict choice. Suppose you have a function called is-a-town that checks a list of town names and returns a truth value. Then:

[Fred Brown lives in sin] matches
[??x lives in ?y:is-a-town]

will fail. With tools like this it becomes almost trivial to write natural-language parsing systems.

The SNAP matcher merely compares a list to a pattern template and returns TRUE or FALSE. Variable assignment is not possible because SNAP employs static scoping whereas POP is dynamically scoped like LISP. A number of restriction functions (e.g., allof, noneof, oneof) are supplied so that, for example, [1 2 [oneof [3 4]] 5] will match [1 2 3 5] but not [1 2 5 5]. The syntax of the SNAP pattern matcher is slightly different from that of the language itself and is far less elegant than that of POP. An additional tool is a list matcher that matches list structures regardless of their contents, so that it can, for instance, check whether two trees are isomorphic.

One feature in SNAP that POP lacks is a mechanism to let you create modules. Such modules are called lids (as in putting on the lid) and you declare them by surrounding a group of definitions with lid...elid. The first line of a lid contains a list of its functions and variables that are to be visible outside it, and all others are hidden.

Other advanced features include lazy list evaluation, right-hand functions, coroutines, updaters, and macros (definitions that are executed at compile time to provide conditional compilation or to alter the language's syntax).

Useful Tools

Given SNAP's intended role in the laboratory, it's not surprising that it has interfaces to machine-code routines, I/O ports, PEEK and POKE, and bit-level operators, which in combination make it capable of driving peripherals such as graphics tablets and instruments. Graphics primitives based on the new Graphics Kernel System (GKS) will be included in the SNAP system.

The library will contain a number of development tools such as a beautifier to print nicely formatted listings, a spelling corrector with knowledge of the syntax, a straightforward trace and pause package, and a calls and called-by cross-referencer. Some of these are already written in SNAP, and an inspection of the source code reveals how easy and compact they can be when list *and* string processing are available. Application-oriented tools include a menu handler that constructs menu-driven user interfaces from lists of prompt strings, a forms handler, and treedraw, which draws trees from list structures. Treedraw is used by the menu handler to print a route map of the menus if the user hits ? for help.

I'll sum up by saying that SNAP combines the best of BASIC, LISP, and FORTH with the readability of Pascal. I have to confess a bias: I'm one of those zealots (crazed by years of BASIC, FORTH, and LISP) who believes that personal computer programming should be interactive. Try-it-and-see hacking really is a faster way to program if you have the right tools. If I could afford a VAX I'd be running POP-11, but in the meantime SNAP might just do.

One thought that strikes me is how much Lisa and Macintosh need a programming system of this sophistication; a glaring contradiction exists between their superb graphics user interface and the impoverished semantics of BASIC and Pascal (even with all the extensions under the sun). ■

FOR MORE INFORMATION

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MRC Applied Psychology Unit
15 Chaucer Rd.
Cambridge, England

POP-11/POPLOG:
Dr. Aaron Sloman
Cognitive Studies Programme
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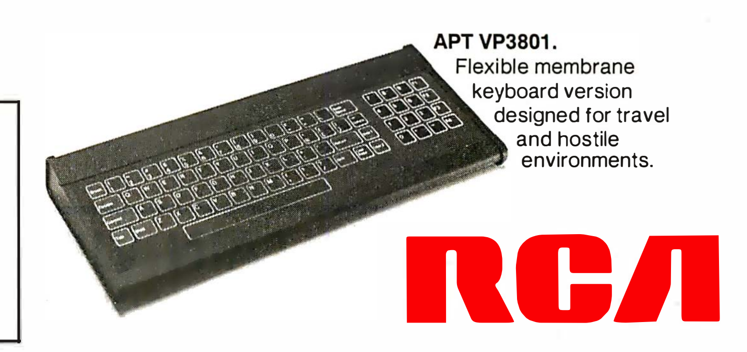
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(continued from page 125)
issues INT 20, control returns to MOUS123 immediately after the call to function 4Bh. All segment registers except CS have been destroyed, but since they all point to the same place, they can be reloaded. Just before it returns control to DOS, MOUS123 prints a message that tells whether the operation was successful or not.

The Interrupt Handler

In the description of mouse function 12 in the Microsoft mouse documentation, an interrupt routine is defined. A bit mask, one of the parameters for interrupt initialization, identifies which of the following conditions will invoke the interrupt handler. The supplied mask calls for a button press or mouse movement, but not for a button release. (The coordination of button presses and releases lets you "drag" the mouse to indicate an entire area rather than a single cursor position.)

At entry time, the register AX contains flags describing the reason for the call, BX gives the button status, and CX and DX contain the coordinates of the mouse. BX is only used to help identify the "both buttons" condition. (At first I found it difficult to press both buttons at the same time, and the program treated them as sequential button presses.) The interrupt handler calls the subroutines required to take care of all the flags set in AX by the mouse driver.

These subroutines receive a pointer to a "state" variable in register BX—one state is for the spreadsheet area and the other is for the menu area. This variable records the last known position of the cursor in that state, its sensitivity to mouse movement, and what characters are to be passed back to the handler for mouse movement or button presses. Pressing both buttons switches between states. From the display area you can switch to the menu area using a slash (/), but to switch from the menu to the display area you must type the escape character (Esc). A customized front-end for another program might have more or fewer states, each with its own movement ratios and button meanings.

Each keystroke is represented by a two-character word. The first byte is the ASCII (American Standard Code for Information Interchange) character representation of the keystroke or its "meaning." The second byte is the "key number" or scan code, a number used only within the IBM PC to map keystrokes into characters. It is irrelevant for our purposes unless the character value is zero. Then you are dealing with an extended ASCII code (like a function key or a keypad key) and the key number tells you which special code you have. The scan codes are given in Appendix K of the DOS 2.0 update to the BASIC manual and in the part of the technical reference manual covering the keyboard. The 2-byte extended ASCII codes are discussed in Appendix G of the BASIC manual and under Keyboard Encoding in the technical reference manual.

In the spreadsheet state, MOUS123 sends the slash character when you push both mouse buttons. In listing 2, "both_ch" represents both a scan code of 53 (decimal) and a character value of 47, the / character. The state structure stores the keystroke representations in the same format used in the keyboard buffer.

Pressing a Button

The simplest subroutines handle button presses. Listing 3 shows the code
(continued)

Listing 1: A *segment of* MOUS123 *showing stack-pointer and segment-boundary manipulations and the passing of parameters.*

```
          mov   sp,offset pgmend + 256 ; set up new stack ptr
          mov   bx,sp                  ; find end of this pgm
          add   bx,15                  ; round to paragraph: stack end
          shr   bx,1
          shr   bx,1                   ; /16 to get paragraphs
          shr   bx,1
          shr   bx,1                   ; ES -> seg, BX = new size
          mov   ah,4ah                 ; setblock: change segment size
          int   21h                    ; change the size
          jc    errstblk               ; handle SETBLOCK error
; Set up parm list for ATTACH
          mov   ax,ds:[2ch]            ;  -> environment from my prefix
          mov   envptr,ax              ;  -> environment for new seg
          mov   cmd_s,cs               ; seg for text
          mov   fcb1_s,cs
          mov   fcb2_s,cs
          mov   bx,offset parm4b       ;  -> parm list
          mov   dx,offset pgm          ;  -> pgm name (driv:name.ext)
          mov   ax,4b00h               ; (f'n), al = 0 (load & execute)
          int   21h                    ; ret code in ax
          mov   dx,offset msg03        ; done msg
          mov   bx,cs                  ; f'n 4b destroys the seg regs
          mov   ss,bx
          mov   ds,bx
          jnc   init800                ; OK, write msg & quit
          . . .
cmd_lin   dw    0                      ; parameters to be passed (null)
pgm       db    'lotus.com',0          ; Name of pgm to execute (w/ path)
parm4b:                                ; parm list used by f'n 4B
envptr    dw    0                      ;  -> environment string for new seg
cmd_o     dw    cmd_lin                ; offset for cmd line
cmd_s     dw    0                      ; segment for cmd line
fcb1_o    dw    5Ch                    ; offset & seg for FCB1 @ 5C
fcb1_s    dw    0
fcb2_o    dw    6Ch                    ; offset & seg for FCB2 @ 6C
fcb2_s    dw    0
pgmend    dw    10 dup (0)             ; low end of stack
```

used when the left button is pressed. The program saves AX since it is used in the routine and it uses the pointer in BX to select the left-button-press character from the current state structure. It also disables interrupts while it uses the ISET routine to insert the chosen character into the keyboard buffer. Then the routine restores AX and exits.

Tracking the Cursor

The mouse-tracking routine, CURS, is the most complex. It's also the only routine that may put more than one character into the keyboard buffer. It's really a double routine since it treats horizontal and vertical movement separately.

The Microsoft mouse tracks its position on a virtual screen 640 pixels (picture elements) wide and 200 pixels high. Position (0,0) is the upper left-hand corner of the screen and (639,199) is the lower right-hand corner. The mouse cursor can move pixel by pixel on a screen driven by the color/graphics board. For text displays like the Lotus 1-2-3 spreadsheet, where the cursor moves character by character, only pixel addresses in multiples of eight are valid. For each coordinate, the interrupt handler determines whether the mouse moved and, if it did, calculates how far by adding the pixels left over from the last calculation and subtracting the previous location value (see listing 4). If the difference is positive, the mouse moves down or to the right. If it is negative, it moves up or to the left.

While the width of each spreadsheet column is variable, MOUS123 can't tell which column is which or where the cursor is located. Therefore, it uses a fixed ratio of distance to the number of cursor-movement key presses. The ratio, "horz_ratio," of five horizontal characters (40 pixels) to one arrow key seems comfortable and allows you to position the mouse at the desired cell without overshooting or undershooting. Since cells are always one character high, the natural vertical ratio is one character (8 pixels) to one arrow key as specified in "vert_ratio." The distance moved (in pixels) is divided by the ratio to get the number of arrow keys to insert. The new current position and remainders are saved. If MOUS123 didn't save the remainders, you would never see any horizontal cursor movement because one interrupt wouldn't report enough pixels to move the cursor and partial characters couldn't be accumulated across interrupts.

Just before CURS exits, it checks the current position of the mouse. If it is near the screen edge, CURS repositions it to the center by changing the values of "cursh" and "cursv" as required. This ensures that the mouse can continue to move the cursor to the limits of the spreadsheet. Most mouse-based applications deal with one screen at a time and handle scrolling in another way. MOUS123 can't do that because it doesn't control the screen directly.

Listing 2: *The routine from* MOUS123 *that defines the fields used to track the cursor.*

```
state        struc
cursv        dw    200/2         ; last vertical pixel loc
cursh        dw    640/2         ; last horizontal pixel loc
remv         dw    4             ; uncounted vert pixels (rem'der)
remh         dw    0             ; uncounted horiz pixels (rem'der)
vert_ratio   dw    8             ; sensitivity, mickeys/byte vert.
horiz_ratio  dw    40            ; cursor sensitivity horizontally
lbut_ch      dw    28*256 + 13   ; ah = scan code, al = char value <CR>
rbut_ch      dw    59*256        ; F1 key (char value = 0): HELP
both_ch      dw    53*256 + 47   ; change state: '/' or Esc
up_ch        dw    72*256        ; cursor up
down_ch      dw    80*256        ; cursor down
left_ch      dw    75*256        ; cursor left
right_ch     dw    77*256        ; cursor right
state        ends
```

Listing 3: *The* MOUS123 *code that is in control when the left mouse button is pressed.*

```
lbut    proc    near
        push    ax
        mov     ax,[bx].lbut_ch     ; al = ASCII, ah = key #
        cli                         ; hold all interrupts
        call    iset                ; stuff the buffer
        sti                         ; interrupts back on
        pop     ax
        ret
lbut    endp
```

The Keyboard Buffer

Information is passed to Lotus 1-2-3 by converting it to characters and inserting them into the system's keyboard buffer. Each keystroke takes 2 bytes in the buffer—the key position number or scan code takes one and the character value the other. A capital "A", for example, has a key position number of 30 (decimal) and a character value of 65 (also decimal) while a small "a" has the same key position number of 30 but a character value of 97. By the time a character appears in this buffer, all shifting has been taken into account. The process is described in the BIOS (basic input/output system) listing in the technical reference manual following the "Keyboard Interrupt Routine."

Function keys and arrow keys all have the character value zero and are identified by their position numbers.

(continued)


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Listing 4: *The* MOUS123 *routine for handling cursor movement.*

```
;   cx = horizontal cursor position (pixels)
;   dx = vertical cursor position (pixels)
;       Suppress interrupts to ensure serialization
curs     proc    near
         cli                          ; suppress interrupts
         push    ax
         push    cx                   ; save horizontal pos'n
         push    dx                   ; save vert pos'n
         sub     dx,[bx].cursv        ; get change in vert pos'n
         jz      curs50               ; no change
;   how many positions up or down?
         mov     ax,dx                ; set for division
         add     ax,[bx].remv         ; leftover pixels from last time
         cwd                          ; propagate sign of ax to dx
         idiv    [bx].vert_ratio      ; get # of chars vertical (+ or -)
         mov     [bx].remv,dx         ; save leftover pixel count
         push    cx                   ; save cx during repeat
         mov     cx,ax                ; quotient, # of chr moved
         mov     ax,[bx].down_ch      ; prime reg: positive => down
         cmp     cx,0                 ; any chrs?
         je      curs48               ; no chars, skip
         jg      curs30               ; positive: go use right arrow
         neg     cx                   ; abs (cx), make positive
         mov     ax,[bx].up_ch        ; up arrow char
curs30:  call    iset                 ; put char into keyboard buffer
         loopnz  curs30
curs48:  pop     cx                   ; restore value from repeating
curs50:  pop     dx
         mov     [bx].cursv,dx        ; save vert position for next time
```

All the codes that MOUS123 uses are stored in the state structures.

Talking to Lotus 1-2-3

The ISET routine actually passes mouse information to Lotus 1-2-3. The routines that handle motion and key presses call ISET for each character they want to pass, first putting the 2-byte code in register AX. ISET moves the pointers to the beginning and the end of the keyboard buffer located at 40:1E (the segment register contains 40h, the displacement 1Eh), at label KB_BUFFER in the BIOS listing. ISET's calling routines disable the interrupts before it is called to ensure that no other routine (like the keyboard-interrupt handler) can manipulate the pointers or the buffer until it is finished. CURS disables the interrupts during its entire execution because it may call ISET several times and needs to ensure that the mouse interrupts are handled in the order they occur and do not become intermixed.

Beyond Lotus 1-2-3

With minor changes to the state values for sensitivity and the character codes for button presses, you could use MOUS123 with many screen-oriented programs. WordStar addicts could easily modify the state definition to use Ctrl-E instead of the up arrow, Ctrl-D instead of the right arrow, etc. Key redefinition using the ANSI.SYS device driver in DOS 2.0 could further expand the possibilities.

MOUS123 works with the Lotus 1-2-3 version 1 and 1A, DOS 2.0, and both IBM color and monochrome monitors. It would be nice to say it works with other mice, but there is no standard mouse interface.

Nevertheless, a mouse performs a useful function for all users by using natural, comfortable hand and arm movements on a desktop to point at items on the screen. MOUS123 and similar programs can extend the usefulness of a mouse to many screen-oriented programs that don't normally support one. ■

(continued from page 127)

10^{250}, now meets all of our requirements, and it is inconceivable at this time that such an *N* could be factored.

The CHOOSEP algorithm does the above but does not check that "neither $p+1$ nor $q+1$ consists entirely of rather small prime factors." Nor does it use the numbers of digits shown unless called with those numbers. Knuth does not specify how small are "rather small prime factors" and determination of the method is left to his reader.

By the way, the Smith article states the condition that "$p-1$ and $q-1$ should both contain at least one large prime factor"; note the minus, rather than plus. Smith's mention that "the ratio p/q should not approximate a simple fraction" is covered by *p* and *q* differing in magnitude by several powers of 10 in Knuth's algorithm.

The CHOOSEP function first assigns 0 to *C* and 1 to *A*; in a loop *C* counts to the *N* passed to the function, while *A* is multiplied by 10 each time, so that *A* comes out as the *N* power of 10. The next loop asks for a random number between zero and that value of *A*, 10^N. When the length is the full length desired, *N*, the loop, is exited. The random number is in *P*1, and the reference to function NXPRIME gets the next prime equal to or larger than *P*1, and this is assigned into *P*1.

The next few lines, including a couple of loops, similarly find another large random number, this time of length *N*2, *which is put into P*2. Initially, *K* is then set to *P*2 + MOD (*P*1 – *P*2,3). This makes *K* congruent to (≡) *P*1 mod 3, as Knuth's algorithm demands. Because *K* also must be even, the loop adds 3 if *k* is odd, making it even while preserving its congruence mod 3. The loop, rather than a simple IF...THEN, is a result of muSimp's requirement that all actions dependent on an IF (actually WHEN

(continued)

Listing 1: *The highest-level module in the key-selection system, with a sample run, producing 101-digit keys. The key* N *is public, used in encoding and decoding, while* D *is kept secret, used only in decoding.*

```
? DISPLAY(SETUP);
@:

FUNCTION SETUP (),
  RANDOMIZE (),
  P: CHOOSEP (33, 8),
  Q: CHOOSEP (45, 16),
  N: P * Q,
  D: QUOTIENT (2*(P – 1)*(Q – 1) + 1, 3),
ENDFUN

? P;Q;N;D;
@:
5669682733234183949743401862732403737825
1

? @:
1112245192858508592950635202981592638763
4950671133592643053331

? @:
6306077365072611053931059220460476141900
0135895287313649294616210624533300703021
096023498624002756081

? @:
4204051576715074035954039480306984094599
9349100062970093801072585729479577483173
444625171960467381667

? SYSTEM();
@:

1)PR# 0
```

Listing 2: *The function* CHOOSEP *that chooses primes in the appropriate range.*

```
? DISPLAY(CHOOSEP);
@:

FUNCTION CHOOSEP (N, N2, P1, P2, K, C, A, P),
  C: 0,
  A: 1,
  LOOP
    C: C + 1,
    WHEN C > N EXIT,
    A: A * 10,
  ENDLOOP,
  LOOP
    P1: LRAND (A),
    WHEN LENGTH (P1) = N EXIT,
  ENDLOOP,
  P1: NXPRIME (P1),
  C: 0,
  A: 1,
  LOOP
    C: C + 1,
    WHEN C > N2 EXIT,
    A: A * 10,
  ENDLOOP,
  LOOP
    P2: LRAND (A),
    WHEN LENGTH (P2) = N2 EXIT,
  ENDLOOP,
  K: P2 + MOD (P1 – P2, 3),
  LOOP
    WHEN MOD (K, 2) = 0 EXIT,
    K: K + 3,
  ENDLOOP,
  LOOP
    P: K*P1 + 1,
    WHEN PRIME (P) EXIT,
    K: K + 6,
  ENDLOOP,
  P,
ENDFUN
```

Listing 3: *The functions for producing pseudorandom numbers for the RSA system.*

```
? DISPLAY(LRAND);
@:

FUNCTION LRAND (N),
  RAND#: RND (),
  LOOP
    WHEN RAND# > N EXIT,
    RAND#: RAND# * 67099547 + RND(),
  ENDLOOP,
  RAND#: MOD (RAND#, N),
ENDFUN

? DISPLAY(RND);
@:

FUNCTION RND (),
  RND#: MOD (RND# * 8192, 67099547),
ENDFUN

? DISPLAY(RANDOMIZE);
@:

FUNCTION RANDOMIZE (),
  PRINT ('ENTERSEED),
  SCAN (),
  RND#: SCAN,
  RND (),
ENDFUN
```

Listing 4: *The functions for finding the next prime number equal to or larger than the one given, and for testing if a given number is prime, according to a probabilistic primality test, repeated 50 times for almost certain assurance of primality.*

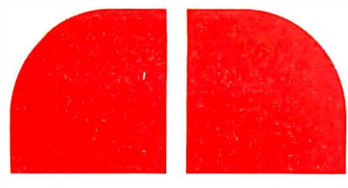
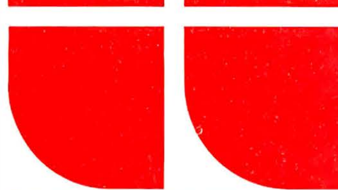
```
? DISPLAY(NXPRIME);
@:

FUNCTION NXPRIME (X),
  LOOP
    WHEN MOD (X, 2) = 1 EXIT,
    X: X + 1,
  ENDLOOP,
  LOOP
    WHEN PRIME (X),
      X EXIT,
    X: X + 2,
  ENDLOOP,
ENDFUN

? DISPLAY(PRIME);
@:

FUNCTION PRIME (N, I, X, J, Y, Q, K, T),
  WHEN MOD (N, 2) = 0,
    FALSE EXIT,
  Q: FIRST (ODDFACT (N - 1));
  K: REST (ODDFACT (N - 1)),
  I: 0,
  LOOP
```

(continued)

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```
    LOOP
      X: LRAND (N);
      WHEN X > 1 EXIT,
    ENDLOOP,
    J: 0,
    Y: POWERMOD (X, Q, N),
    LOOP
      WHEN J=0 and Y=1 OR Y=N-1,
        T: TRUE EXIT,
      WHEN J>0 and Y=1,
        T: FALSE EXIT,
      J: J + 1,
      WHEN J = K,
        T: FALSE EXIT,
      Y: MOD (Y * Y, N),
    ENDLOOP,
    WHEN NOT T,
      FALSE EXIT,
    I: I + 1,
    WHEN I > 50,
      TRUE EXIT,
    ENDLOOP,
ENDFUN

? DISPLAY(ODDFACT);
@:

FUNCTION ODDFACT (N, K),
  K: 0,
  LOOP
    WHEN MOD (N, 2) = 1,
      ADJOIN (N, K) EXIT,
    N: QUOTIENT (N, 2),
    K: K + 1,
  ENDLOOP,
ENDFUN
```

Listing 5: *A recursively defined function for raising a large number to a large power mod a third number. This is not incorporated into the system, as it runs out of memory rapidly through its use of a stack.*

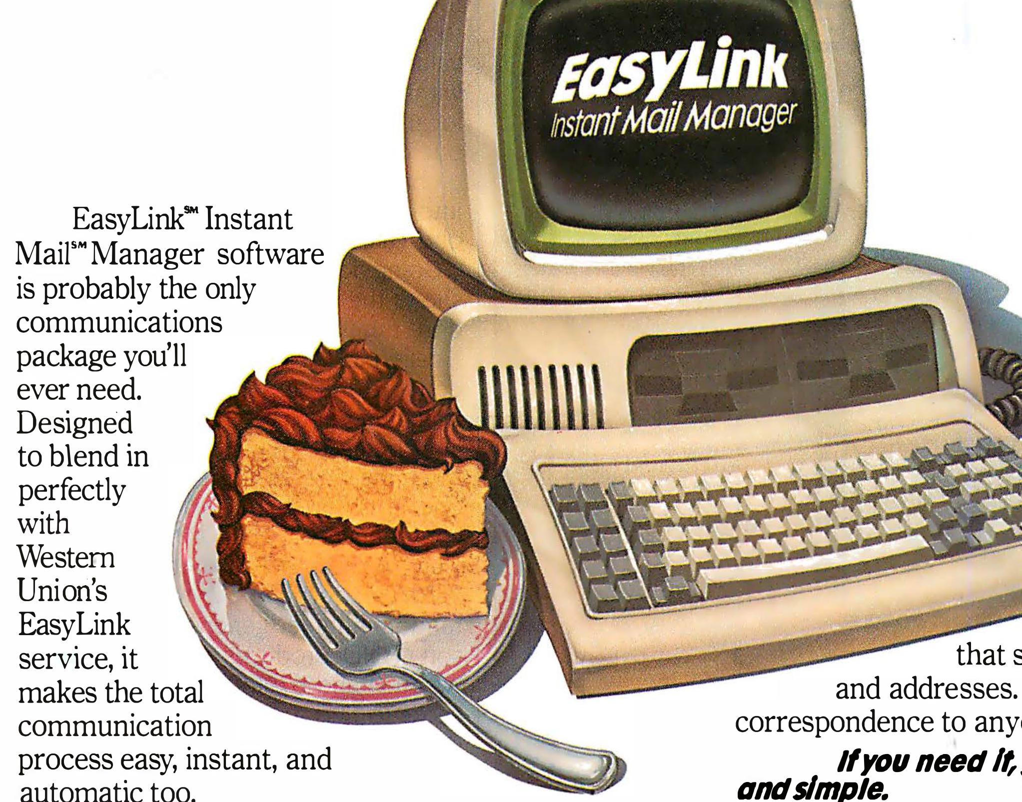
```
? DISPLAY(POWERMOD);
@:

FUNCTION POWERMOD (X, Y, N),
  WHEN Y = 0,
    1 EXIT,
  WHEN MOD (Y, 2) = 1,
    MOD (X * POWERMOD (X, Y - 1, N), N)
      EXIT,
  POWERMOD (MOD (X * X, N), QUOTIENT (Y, 2), N),
ENDFUN

? SYSTEM ();
@:

2)PR# 0
```

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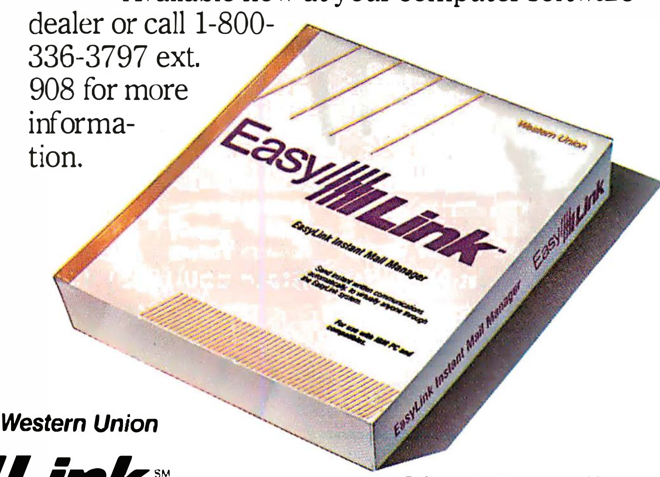
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in the muSimp language) terminate in an EXIT.

The final value for k is then found by continually adding 6 until $kp_1 + 1$ is prime. Adding 6 preserves k's being even and its congruence to p_1 mod 3. This $kp_1 + 1$ is then assigned to p, which is then returned as the value chosen. Remember that P within the CHOOSEP function is a local variable, and that the result of one call to CHOOSEP goes into the global variable P and the other goes into global variable Q from the second call in SETUP (listing 1).

Going down one level now, listing 3 shows the functions defined for random numbers. When I needed one, I called LRAND with an argument equal to the upper limit of the random number to be chosen, the lower limit being 0.

Let me first describe the function one level lower. RND uses a linear congruence, one in fact proposed by Hare, Russ, and Faulkner in a *Call—A.P.P.L.E.* article to replace the random-number generator in Applesoft. RND produces a number between 0 and 67099547. As LRAND seeks to find a random number that could conceivably be very much larger, it treats each number chosen by RND as a digit in a base-67099547 number. It follows the base-conversion procedure of multiplying each partial sum by the base and adding the next "digit." This is done until a large enough number is built; then it is brought down to size by taking its value mod the parameter passed to LRAND.

The RANDOMIZE function in the same listing prints a prompt to enter a seed. The reference to the SCAN function then causes a wait for user input terminated by a carriage return. What the user typed is put into a variable called SCAN, which RANDOMIZE then assigns into RND#, the global variable that is used by RND as its seed and new random value. RND is then called once to warm up the generator.

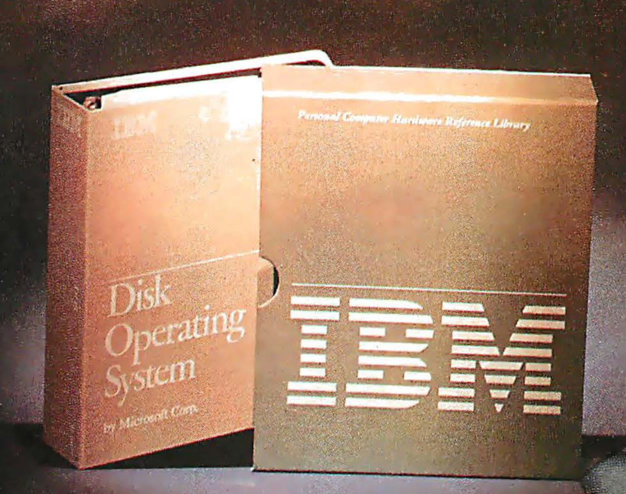
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random-number generator and install it in the place of this RND to prohibit someone's determining your public or private key, n or d.

Listing 4 shows the functions for finding the next prime equal to or greater than a given number and for testing a number for its being prime. The former, NXPRIME, first loops until the internal variable corresponding to the passed parameter is odd. (Obviously it needs to be done just once, but the loop structure is necessary to satisfy WHEN's requirement to EXIT.) The second loop then continues to add 2, testing all successive odd numbers until a prime is found, at which time PRIME returns a value of TRUE.

That function, PRIME, is listed next in listing 4. It follows Knuth's Algorithm P for a probabilistic prime-number test. All the variables but N in the parameter list merely set up local variables, as they are not passed as arguments in the calls (references) to PRIME.

First, PRIME checks if N is even; if so, FALSE is returned as the value of the function. A few extra checks here for multiples of 3, 5, and 7 to avoid more complicated checks might speed up the processing of most non-primes, but the function does work as shown.

Knuth's algorithm starts from a point where k and q are chosen such that $n = 1 + 2^k q$ where q is odd. The PRIME function determines these by calling ODDFACT with $n - 1$, to be expressed as $2^k q$. (Named such because q is the largest *odd* factor of the argument passed.) ODDFACT produces a tree structure with only two branches attached to its single node. The first is the value appropriate for q, the other for k.

FIRST and REST are built into the muSimp language and are much more mnemonic than the equivalent LISP car and cdr. With only two branches, here each gives one of the branches.

With k and q chosen, the probabilistic algorithm is performed 50 times, as recommended by Knuth (page 388), by setting I to 0 and in-

(continued)

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Z80-DMA	40	Direct Memory Access Circuit	9.95
Z80-P10	40	Parallel I/O Interface Controller	3.95
Z80-S10/0	40	Serial I/O (TxCB and RxCB Bonded)	12.95
Z80-S10/1	40	Serial I/O (Lacks DTRB)	12.95
Z80-S10/2	40	Serial I/O (Lacks SYNCB)	12.95
Z80-S10/9	40	Serial I/O	12.95
Z80A	40	CPU (MK3880N-4)(780C-1) 4MHz	4.49
Z80A-CTC	28	Counter Timer Circuit	4.95
Z80A-DART	40	Dual Asynchronous Rec./Trans.	9.95
Z80A-DMA	40	Direct Memory Access Circuit	12.95
Z80A-P10	40	Parallel I/O InterfaceController	3.95
Z80A-S10/0	40	SerialI/O(TxCBandRxCBbonded)	12.95
Z80A-S10/1	40	SerialI/O(Lacks DTRB)	12.95
Z80A-S10/2	40	Serial I/O(LacksSYNCB)	12.95
Z80A-S10/9	40	Serial I/O	12.95
Z80B	40	CPU (MK3880N-6) 6MHz	9.95
Z80B-CTC	28	Counter Timer Circuit	12.95
Z80B-DART	40	Dual Asynch. Receiver/Transmitter	19.95
Z80B-P10	40	Parallel I/O Interface Controller	12.95
Z8001	48	CPU Segmented	44.95

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MC6502A	40	MPU with clock and RAM (2MHz)	6.95
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MC6800	40	MPU	2.95
MC6802CP	40	MPUwith clockandRAM	7.95
MC6809E	40	CPU (1MHz) External (Locking)	14.95
MC6821	40	Peripheral Inter. Adapt (MC6820)	2.95
MC6828	24	Priority Interrupt Controller	15.95
MC6830L8	24	1024x8-bit ROM (MC68A30-8)	9.95
MC6850	24	Asynchronous Comm. Adapter	3.95
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MC68488P	40	GeneralPurpose Int. Adapter	9.95
MC68652P2	40	Multi. ProtocolComm. Controller	24.95
MC68661PB	28	Enhanced Prog. Comm. Int.	9.95
MCM68764	24	64K EPROM (450ns)	24.95
SY6522	40	Peripheral Inter. Adapter	7.95

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INS8080A	40	CPU	2.95
INS8154	40	128ByteRAM 16-BitI/O	13.95
8156	40	RAMwithI/O Port andTimer	6.95
DP8212	24	8-bit Input/Output(74S412)	2.25
DP8214	24	Priority InterruptControl	2.95
DP8216	16	Bi-Directional BusDriver	1.95
DP8224	16	Clock Generator/Driver	2.25
DP8226	16	Bus Driver	2.25
DP8228	28	System Cont./Bus Driver (74S428)	3.49
DP8238	28	System Controller (74S438)	4.49
INS8243	24	I/O Expander for 48 Series	3.95
INS8245	18	16-KeyKeyboardEncoder (74C922)	4.49
INS8246	20	20-Key Keyboard Encoder(74C923)	4.95
INS8247	28	DisplayController (74C911)	8.95
INS8248	28	DisplayController (74C912)	8.95
INS8250N	40	Asyn. Comm. Element	10.95
DP8251	28	Prog. Comm. I/O (USART)	4.49
DP8253	24	Prog. IntervalTimer	6.95
DP8255	40	Prog. Peripheral I/O(PPI)	4.49
DP8257	40	Prog. DMA Control	5.95
DP8259	28	Prog. Interrupt Control	6.95
DP8275	40	Prog. CRT Controller	29.95
DP8279	40	Prog. Keyboard/Display Interface	8.95
8284	18	Clock Generator/Driver	6.50
8288	20	BusController	9.95
DP8303	20	8-Bit Tri-StateBi-Directional Trans.	3.95
DP8304	20	8-bit Bi-Directional Receiver	2.95
DP8307	20	8-bit Bi-Directional Receiver	2.95
DP8308	20	8-bit Bi-Directional Receiver	2.95
DP8310	20	Octal Latched Peripheral Driver	4.95
8741	40	8-bitUniv. Peripheral Interface	29.95

DISK CONTROLLERS

INS1771-1	40	Single Density	16.95
FD1791	40	Single/Dual Density (Inv.)	29.95
FD1793	40	Single/Double Density (True)	29.95
FD1795	40	Dual Density/Side Select (Inv.)	29.95
FD1797	40	DualDensity/SideSelectTrue	29.95

SPECIAL FUNCTION

DS0026CN	8	DualMOS Clock Driver (5MZ)	1.95
INS2651	28	Communication Chip	8.95
MC3470P	18	Floppy Disk Read Amp System	4.95
MM54240N	24	Asynchronous Transmitter/Receiver	5.95
MM58167AN	24	Microprocessor RealTime Clock	8.95
MM58174AN	16	Micro. CompatibleTimeClock	7.95
COP402N	40	Microcontroller w/64-digit RAM and Direct LED Drive	5.95
COP402MN	40	Microprocessor w/64-digit RAM & Direct LED Drive w/N Buss Int.	5.95
COP470N	20	32-segVACFluor.Drvr. (20-pinpkg.)	3.25
MM5369AA/N	8	Prog. Oscillator/Divider (60Hz)	1.79
MM5369EST	8	Prog. Oscillator/Divider (100Hz)	1.95

DYNAMIC RAMS

Part No.	**Pins			Price
1103	18	1024x1	(300ns)	.99
4027	16	4096x1	(250ns)	2.49
4116N-2	16	16,384x1	(150ns)	1.89 - 8/14.95
4116N-3	16	16,384x1	(200ns)	1.69 - 8/12.95
4116N-4	16	16,384x1	(250ns)	1.49 - 8/10.95
4164N-150	16	65,536x1	(150ns)	6.95 - 8/49.95
4164N-200	16	65,536x1	(200ns)	5.95 - 8/44.95
MM5261	18	1024x1	(300ns)	.49 - 8/1.95
MM5262	22	2048x1	(365ns)	.10
MM5270	18	4096x1	(250ns) MK4096	4.95
MM5280	22	4096x1	(200ns) 2107	3.95

NEW 256K DYNAMIC RAM

41256 16 262,144x1 (200ns)....44.95

MM5298-3	16	8192x1	(200ns)	1.69

STATIC RAMS

1101	16	256x1	(650ns)	1.49
2101	22	256x4	(450ns) 8101	2.49
2102	16	1024x1	(350ns)	.89
21L02	16	1024x1	(450ns) L.P.	1.49
2111	18	256x4	(450ns) 8111	2.95
2112	16	256x4	(450ns) MOS	1.95
2114	18	1024x4	(450ns)	1.49 - 8/9.95
2114L	18	1024x4	(450ns) L.P.	1.95 - 8/13.95
2114-2	18	1024x4	(200ns)	1.75 - 8/11.95
2114L-2	18	1024x4	(200ns) L.P.	2.25 - 8/14.95
2147	18	4096x1	(70ns)	4.95
2148	18	1024x4	(70ns)	4.95
TMS4045	18	1024x4	(450ns)	3.95
TMS40L47-45	20	1024x4	(450ns)	2.95
5101	22	256x4	(450ns) CMOS	2.95
MM5257	18	4096x1	(450ns) 4044	4.95
HM6116P-3	24	2048x8	(150ns) CMOS	5.95
HM6116P-4	24	2048x8	(200ns) CMOS	4.95
HM6116LP-4	24	2048x8	(200ns) L.P. CMOS	5.49
HM6264P-15	28	8192x8	(150ns) CMOS	36.95
HM6264LP-15	28	8192x8	(150ns) L.P. CMOS	41.95
27LS00	16	256x1	(80ns) L.P.	6.95
7489	16	16x4	(50ns) 3101	2.25
74C920	22	256x4	(250ns)	3.95
74C921	18	256x4	(250ns) CMOS	3.95
74C929	16	1024x1	(250ns) CMOS (6501)	3.95
74C930	18	1024x1	(250ns) CMOS (6518)	3.95
74S189	16	16x4	(35ns) 93405	1.95
74S200	16	256x1	(80ns) 93410	3.95
74S206	16	256x1	(60ns) 93411	3.95
74S289	16	16x4	(35ns) 3101	2.25
82S10	16	1024x1	(50ns) O.C. (93415)	3.95
82S25	16	16x4	(50ns) O.C. (74S289)	2.25

PROMS / EPROMS

1702A	24	256x8	(1us)	4.95
2708	24	1024x8	(450ns)	3.95
2708-5	24	1024x8	(550ns) SM00246	2.95
TMS2516	24	2048x8	(450ns) 2716	5.95
TMS2532	24	4096x8	(450ns) NMC2532	6.95
TMS2564	28	8192x8	(450ns)	14.95
TMS2716	24	2048x8	(450ns) 3 voltage	9.95
2716	24	2048x8	(450ns)	4.95
27C16	24	2048x8	CMOS	19.95
2716-1	24	2048x8	(350ns)	5.95
27160-5	24	2048x8	(550ns)	4.49
2732	24	4096x8	(450ns)	6.95
2732A-3	24	4096x8	(300ns)	7.95
2732A-4	24	4096x8	(450ns) 21V	6.95
27320-4	24	4096x8	(550ns)	5.95
27580-A	24	1024x8	(450ns)	2.95
2764-4	28	8192x8	(450ns)	6.95
2764-3	28	8192x8	(300ns)	7.95
27C64	28	8192x8	CMOS	29.95
MCM68764	24	8192x8	(450ns)	24.95
27128	28	16,384x8	(450ns) 128K EPROM	24.95
74S188	16	32x8	PROM O.C. (6330-1)	1.49
74S287	16	256x4	PROM T.S. (6301-1)	1.95
74S288	16	32x8	PROM T.S. (6331-1)	1.95
74S387	16	256x4	PROM O.C. (6300-1)	1.95
74S471	20	256x8	PROM T.S. (6309-1)	5.95
74S472	20	512x8	PROM T.S. (6349-1)	4.95
74S473	20	512x8	PROM O.C. (6348)	4.95
74S474	24	512x8	PROM T.S. (DM87S296N)	4.95
74S475	24	512x8	PROM O.C. (6340)	4.95
74S476	18	1024x4	PROM T.S.	6.95
74S478	24	1024x8	PROM T.S.	8.95
74S570	16	512x4	PROM O.C. (6305)	2.95
74S571	16	512x4	PROM T.S. (6306)	2.95
74S572	18	1024x4	PROM O.C. (6352)	4.95
74S573	18	1024x4	PROM T.S. (82S137)	4.95
82S23	16	32x8	PROM O.C. (27S18)	2.95
82S115	24	512x8	PROM T.S. (27S15)	9.95
82S123	16	32x8	PROM T.S. (27S19)	2.95
82S126	16	256x4	PROM O.C. (27S20)	2.95
82S129	16	256x4	PROM T.S. (27S21)	2.95
82S130	16	512x4	PROM O.C. (27S12)	3.95
82S185	18	2048x4	PROM T.S. (TBP24S81)	9.95
82S191	24	2048x8	(80ns)	14.95
DM87S180N	24	1024x8	PROM O.C. (82S180)	9.95
DM87S181N	24	1024x8	PROM T.S. (82S181)	9.95
DM87S184N	18	2048x4	PROM O.C. (82S184)	9.95
DM87S185N	18	2048x4	PROM T.S. (82S185)	9.95
DM87S190N	24	2048x4	PROM O.C. (82S190)	14.95
DM87S191N	24	2048x8	PROM T.S. (82S191)	14.95

DATA ACQUISITION

DC10		Mostek DC/DC Convert. +5V to -9V	2.95
MC3470P	18	Floppy Disk Read AMP System	4.95
MC1408L7	16	7-bit D/A Converter (DAC0807LCN)	1.49
MC1408L8	16	8-bit D/A Converter (DAC0808LCN)	2.25
ADC0803LCN	20	8-bit A/D Converter (±1/2LSB)	4.95
ADC0804	20	8-bit A/D Converter (1LSB)	3.49
DAC0806	16	8-bit D/A Converter (0.78% Lin.)	1.95
ADC0809	28	8-bit A/D Converter (8-Ch. Multi.)	4.49
ADC0817	40	8-bit A/D Converter (16-Ch. Multi.)	9.95
DAC1000	24	10-bit D/A Conv. Micro. Comp. (0.05%)	7.95
DAC1008	20	10-bit D/A Conv. Micro. Comp. (0.20%)	6.95
DAC1020	16	10-bit D/A Conv. (0.05% Lin.)	7.95
DAC1022	16	10-bit D/A Conv. (0.20% Lin.)	5.95
DAC1222	18	12-bit D/A Conv. (0.20% Lin.)	6.95
LM334Z		Constant Current Source	1.19
LM335Z		Temperature Transducer	1.40
LM399H		Temp. Comp. Prec. Ref. (.5ppm/C°)	5.00
AY-5-1013A	40	30K Baud Uart (TR1602)	3.95

LOW PROFILE (TIN) SOCKETS

	1-9	10-99	100-up
8 pin LP	.16	.14	.13
14 pin LP	.17	.15	.14
16 pin LP	.19	.17	.16
18 pin LP	.26	.24	.23
20 pin LP	.30	.27	.25
22 pin LP	.31	.28	.26
24 pin LP	.33	.30	.28
28 pin LP	.40	.37	.35
36 pin LP	.46	.42	.39
40 pin LP	.49	.46	.43

SOLDERTAIL (GOLD) STANDARD

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14 pin SG	.43	.39	.37
16 pin SG	.47	.43	.41
18 pin SG	.53	.49	.47
24 pin SG	.69	.65	.61
28 pin SG	.81	.76	.72
36 pin SG	1.09	1.03	.97
40 pin SG	1.21	1.14	1.08

LP

SG

ST

WW

SOLDERTAIL STANDARD (TIN)

	1-9	10-99	100-up
14 pin ST	.29	.27	.25
16 pin ST	.34	.32	.30
18 pin ST	.38	.36	.34
20 pin ST	.45	.43	.41
24 pin ST	.49	.46	.43
28 pin ST	.69	.67	.63
40 pin ST	.99	.95	.89

WIRE WRAP SOCKETS (GOLD) LEVEL #3

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8 pin WW	.49	.45	.42
10 pin WW	.65	.62	.59
14 pin WW	.65	.62	.59
16 pin WW	.69	.65	.61
18 pin WW	.89	.85	.79
20 pin WW	1.09	1.05	.99
22 pin WW	1.25	1.19	1.15
24 pin WW	1.29	1.23	1.18
28 pin WW	1.59	1.50	1.45
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The DT1050 is a standard DIGITALKER kit encoded with 137 separate and useful words, 2 tones, and 5 different silence durations. The words and tones have been assigned discrete addresses, making it possible to output single words or words concatenated into phrases or even sentences. The "voice" output of the DT1050 is a highly intelligible male voice. Female and children's voices can be synthesized. The vocabulary is chosen so that it is applicable to many products and markets.

The DT1050 consists of a Speech Processor Chip, MM54104 (40-pin) and two (2) Speech ROMs MM52164SSR1 and MM52164SSR2 (24-pin) along with a Master Word list and a recommended schematic diagram on the application sheet.

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INTERSIL

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7045EV/Kit*	28	Stopwatch Chip.XTL	19.95
7106CPL	40	3½ Digit A/D (LCD Drive)	9.95
FE02030		3½ Digit LCD Display for 7106 & 7116	19.95
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7107CPL	40	3½ Digit A/D (LED Drive)	11.95
7107EV/Kit*	40	IC. Circuit Board. Display	29.95
7116CPL	40	3½ Digit A/D LCD Dis. HLD.	16.95
7201IJS		Low Battery Volt Indicator	2.25
7205IPG	24	CMOSLED Stopwatch/Timer	12.95
7205EV/Kit*	24	Stopwatch Chip,XTL	14.95
7206CJPE	16	Tone Generator	4.95
7206CEV/Kit*	16	Tone Generator Chip. XTL	7.95
7207AIPD	14	Oscillator Controller	5.95
7207AEV/Kit*	14	Freq. Counter Chip. XTL	7.95
7215IPG	24	4 Func.CMOS Stopwatch CKT	13.95
7215EV/Kit*	24	4 Func. StopwatchChip, XTL	14.95
7216AIJI	28	8 Digit Univ. Counter C.A.	29.95
7216DIPI	28	8 Digit Freq. Counter C.C.	19.95
7217IJI	28	4 DigitLED Up/Down Counter C.A.	10.95
7217AIPI	28	4 Digit LED Up/Down Counter C.C.	11.95
7224IPL	40	LCD 4½ Digit UpCounter DRI	10.95
7226AEV/Kit*	40	5 Function Counter Chip. XTL	74.95

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NEW PRODUCT! 74HC High Speed CMOS

74HC00	14	.59
74HC02	14	.59
74HC03	14	.75
74HC04	14	.59
74HCU04	14	.65
74HC08	14	.59
74HC10	14	.59
74HC11	14	.59
74HC14	14	.85
74HC20	14	.59
74HC27	14	.59
74HC30	14	.89
74HC32	14	.75
74HC42	16	.99
74HC51	14	.75
74HC58	14	.75
74HC73	14	.79
74HC74	14	.79
74HC75	16	.89
74HC76	16	.79
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74HC86	14	.69
74HC107	14	.59
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74HC125	14	.99
74HC132	14	.99
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74HC138	16	1.09
74HC139	16	.99
74HC147	16	1.19
74HC151	16	.89
74HC153	16	.99
74HC154	24	2.49
74HC157	16	.89
74HC158	16	.69
74HC160	16	1.29
74HC161	16	1.29
74HC162	16	1.29
74HC163	16	1.29
74HC164	14	1.29
74HC165	16	2.79
74HC166	16	2.95
74HC173	16	1.69
74HC174	16	.99
74HC175	16	.99
74HC192	16	1.39
74HC193	16	1.39
74HC194	16	1.09
74HC195	16	1.09
74HC237	16	2.95
74HC240	20	1.95
74HC241	20	1.95
74HC242	14	1.95
74HC243	14	1.95
74HC244	20	1.95
74HC245	20	2.49
74HC251	16	.89
74HC253	16	.99
74HC257	16	.89
74HC259	16	1.49
74HC266	14	1.19
74HC273	20	2.89
74HC280	14	3.95
74HC299	20	4.95
74HC366	16	2.39
74HC367	16	2.39
74HC373	20	2.39
74HC374	20	2.39
74HC390	16	1.49
74HC393	14	1.49
74HC533	20	2.39
74HC534	20	2.39
74HC595	16	3.95
74HC688	20	3.19
74HC4002	14	.59
74HC4017	16	2.19
74HC4020	16	1.39
74HC4024	14	1.59
74HC4040	16	1.39
74HC4060	16	1.39
74HC4075	14	.59
74HC4078	14	.69
74HC4511	16	2.69
74HC4514	24	3.79
74HC4538	16	2.39
74HC4543	16	3.49

74HCU04 is unbuffered. All others are buffered.

74C—C/MOS

74C00	14	.35
74C02	14	.35
74C04	14	.29
74C08	14	.35
74C10	14	.35
74C14	14	.69
74C20	14	.35
74C30	14	.35
74C32	14	.39
74C42	16	1.39
74C48	16	1.95
74C73	14	.79
74C74	14	.69
74C85	16	1.95
74C86	14	.39
74C89	16	5.95
74C90	14	1.19
74C93	14	1.19
74C95	14	1.39
74C107	14	.89
74C151	16	2.49
74C154	24	3.49
74C157	16	2.25
74C160	16	1.19
74C161	16	1.19
74C162	16	1.19
74C163	16	1.19
74C164	14	1.49
74C173	16	1.19
74C174	16	1.19
74C175	16	1.19
74C192	16	1.49
74C193	16	1.69
74C195	16	1.39
74C221	16	1.95
74C240	20	1.95
74C244	20	1.95
74C373	20	2.49
74C374	20	2.49
74C901	14	.59
74C903	14	.59
74C906	14	.59
74C911	28	8.95
74C912	28	8.95
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74C917	28	8.95
74C922	18	4.49
74C923	20	4.95
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74C926	18	5.95
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LM304H		1.95
LM305H		.99
LM307CN	8	.45
LM308CN	8	.69
LM309K		1.25
LM310CN	8	1.75
LM311CN	8	.69
LM312H		2.49
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LM317K		3.95
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LM320K-5		1.35
LM320K-12		1.35
LM320K-15		1.35
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LM320T-5		.89
LM320T-12		.89
LM320T-15		.89
LM320T-24		.89
LM322N	14	1.65
LM323K		5.95
LM324N	14	.59
LM329DZ		.65
LM331N	8	3.95
LM334Z		1.19
LM335Z		1.40
LM336Z		1.19
LM337MP		1.15
LM337T		1.95
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LM339N	14	.69
LM340K-5		1.35
LM340K-12		1.35
LM340K-15		1.35
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LM340T-5		.79
LM340T-12		.79
LM340T-15		.79
LM340T-24		.79
LM341P-5		.75
LM341P-12		.75
LM341P-15		.75
LM342P-5		.69
LM342P-12		.69
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LM348N	14	.99
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LF351N	8	.60
LF353N	8	1.00
LF355N	8	1.10
LF356N	8	1.10
LM358N	8	.69
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LM373N	14	3.95
LM377N	14	1.95
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LM380N	14	.89
LM381N	14	1.79
LM382N	14	1.39
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LM386N-3	8	.89
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LM710N	14	.69
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LM733N	14	1.00
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LM1310N	14	1.49
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JM16B	TMS2716 (3-V's)	-5V, +5V, +12V	Motorola, TI	$14.95
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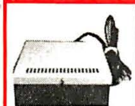
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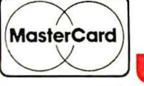
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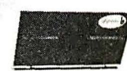


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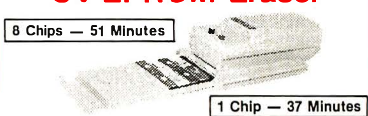
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crementing it by 1 each time until *I* is greater than 50.

The first step of the repeated algorithm is to choose a random number larger than 1 and less than *n*. That is done in the loop calling LRAND. Then, following Knuth's algorithm, *j* is set to 0 and *y* to x^q mod *n*. This is done by a call to POWERMOD, which raises the first parameter to the second parameter power mod the third parameter. That is, if your parameters are *A*, *B*, and *C*, POWERMOD raises A^B and the result is then mod *C*, or A^B mod *C*.

This is the third step:

> If $j = 0$ and $y = 1$, or if $y = n - 1$, terminate [this iteration of the 50 iterations of] the algorithm and say "*n* is probably prime." If $j > 0$ and $y = 1$ [terminate the algorithm and say that "*n* is definitely not prime"].

This is incorporated into a PRIME inner loop by assigning TRUE or FALSE to local variable *T* and exiting that loop. Knuth's next step is to add 1 to *j*, and if $j < k$, then set *y* to y^2 mod *n* and repeat from step 3 above. Otherwise declare "*n* is definitely not prime." The assignment *J*:*J* + 1 is made and if $J = K$, *T* is given the value FALSE and the loop is exited; if *K* is not yet reached, *Y* is reevaluated at *Y* * *Y* mod *N*, and the loop restarted.

When the loop is eventually exited, if *T* is FALSE, the number is declared nonprime by exiting the outer loop with a value of FALSE. This is still the last evaluation before exit and is thus the value returned by the function. If, however, the number has been declared "probably prime," the loop counter *I* is incremented by 1. Then if *I* is still 50 or less, the algorithm starts another iteration with another random assignment of *x*. If, however, *I* exceeds 50, the loop is exited with a TRUE value, which, again, is passed as the value of the function. The odds are astronomically great that *n* is prime.

As mentioned above, PRIME uses ODDFACT to determine the largest odd factor of *n*, *q*, and the power of

(continued)

2 that it is multiplied by, k, to make n. That is, $n = 1 + 2^k q$ where q is odd. ODDFACT successively divides n and its quotients by 2 until the quotient is odd. K counts the number of divisions, and q is the final quotient. The built-in function ADJOIN creates the two-branch binary tree that is returned as the value of ODDFACT.

Finally, we get to POWERMOD, the function that allows the whole structure to work without overflowing the 611-digit capacity of muMath/muSimp. If you had to raise a 100-digit number to a 100-digit power, the result would be a 10,000-digit number. This intermediate result before doing a mod n would cause our algorithm to fail. Smith got around this problem by using a "Russian Peasant" method that uses 7-digit bases and powers without exceeding a 14-digit result in any intermediate step. Likewise, with POWERMOD you can avoid any more than twice as many digits in intermediate results as in the base and the power, assuming the power and the base have the same number of digits.

With POWERMOD you can avoid any more than twice as many digits in intermediate results as in the base and power.

Listing 5 shows my first attempt at POWERMOD. I later abandoned it. Remember, the idea is to get the first parameter raised to the second parameter power mod the third parameter. This function definition has the elegance that LISP programmers like, using the recursive ability of muSimp (or its model, LISP). If the power y is 0, the result is 1. Otherwise, if the power is odd, $x^y \bmod n = x(x^{y-1} \bmod n) \bmod n$, using a recursive call to POWERMOD. Even values of y allow a greater reduction: $x^y \bmod n = (x*x \bmod n)^{y/2}$, mod n, again done recursively, with POWERMOD calling itself. If l is the length of y in decimal notation, POWERMOD would nest about $5l$ levels deep, or 500 levels for a 100-digit power. No intermediate result would be longer than twice the length of x or n. (The $5l$ accounts for a binary representation 3.3 times as long as the decimal, and half the bits being 1-bits, those corresponding to odd quotients, requiring an extra level for reduction to an even value. Each division by 2 corresponds to the removal of 1 from the length of the binary representation.)

Unfortunately, it seems even a nesting level of 50 or so is too much for muSimp, even with 11K bytes of free space left, so I had to go to a second version (see listing 6), using Smith's "Russian Peasant" algorithm translated into muSimp.

In the working nonrecursive version of POWERMOD, local variable M starts out set to 1. In a loop, Y, the power, is continually divided by 2, while X, the base, is squared, until a quotient y is odd. Then the loop is exited. At that time, M is multiplied by the current value of x, then mod n, and again x is squared and y is divided by 2, both mod n, just as in the even case. This whole thing continues until y is eventually 0. Note that the use of an inner loop with a repetition of some of its contents outside that loop is again the result of all WHEN statements in muSimp having to EXIT a loop or function. For that reason we could not have made the multiplication of M by X contingent upon an odd quotient. The final line before the ENDFUN returns M as the power mod n.

Listing 7 shows a small-scale version. I defined SETUP to provide keys to about 19 digits (3+5+5+6), and the keys produced, n = 4424404591-00390237 and d = 294960281403-

Listing 6: *The nonrecursive function for raising to a power* mod n, *used in the* RSA *system.*

```
? DISPLAY(POWERMOD);
@:

FUNCTION POWERMOD (X, Y, N, M),
  M: 1
  LOOP
    WHEN Y = 0 EXIT,
    LOOP
      WHEN MOD (Y, 2) = 1 EXIT,
      X: MOD (X * X, N),
      Y: QUOTIENT (Y, 2),
    ENDLOOP,
    M: MOD (M * X, N),
    X: MOD (X * X, N),
    Y: QUOTIENT (Y, 2),
  ENDLOOP,
  M,
ENDFUN
```

Listing 7: A *testing of the muSimp* RSA *system using short keys* (18 *digits*). *This part sets up the keys.*

```
2)RUN

? DISPLAY(SETUP);
@:

FUNCTION SETUP (),
  RANDOMIZE (),
  P: CHOOSEP (3, 5),
  Q: CHOOSEP (5, 6),
  N: P * Q,
  D: QUOTIENT (2*(P - 1)*(Q - 1) + 1, 3),
ENDFUN

? SETUP ();
@:ENTERSEED835141012
  294960281403280211

? P;Q;N;D;
@: 11963183

? @: 36983506739

? @: 442440459100390237

? @: 294960281403280211

? SAVE(ENV1,2);
@: TRUE
```

280211, have 18 digits each. The prompt ENTERSEED has been answered in this instance with 835141012 to provide a seed for the random-number generator. (Remember, I recommend putting another random-number generator into place (LRAND and RND) and changing the constants of the linear congruence to protect your code further.)

You can store this whole environment on disk, including the values of the variables *P*, *Q*, *N*, *D*, and all the defined functions, by using muSimp's SAVE command. You can restore this environment (called ENV1) using the LOAD command (see listing 8). Then, an encryption and a decryption are performed. The number to be encrypted, 704177610121492, is raised to the third power mod *N*, using POWERMOD.

Remember, the question marks (?) that appear are the prompts, similar to a READY or Apple's (]). The items appearing after them are immediate-mode commands. Usually they are function references, but mention of a variable name terminated with a semicolon and return lists its value. You can make assignments in immediate mode as well. In the example *X*:@, the "at" sign has a special meaning; it is the last evaluation returned. So here you are assigning the encoded value to *X*. Then, to decode, we raise *X* to the *D* mod *N*, again using POWERMOD, and the original value is returned.

This simple example takes about 15 minutes to find *p*, *q*, *n*, and *d*. Encoding takes only a couple of seconds and decoding 15 seconds. Using 37-digit keys requires 45 minutes to produce a set of *p*, *q*, *n*, and *d*, but only a couple of seconds to encode (cube) and about one minute to decode (find the cube root) a message.

Listing 9 shows that SETUP from listing 1 produces 101-digit keys. The keys themselves take about eight hours to produce. Encoding takes under 30 seconds, and decoding about 15 minutes. Note that you have to set up your key only once, so eight hours is not too long to wait.

(continued)

Listing 8: *The keys of Listing 7 reloaded into the system and used in coding and decoding a number, the former by cubing* mod N, *the latter by taking the cube root through the use of raising to the* D *power, as* D *was chosen so as to have this effect in the modular arithmetic used.*

```
? LOAD(ENV1,2);
@:

? N;
@: 442440459100390237

? D;
@: 294960281403280211

? POWERMOD(704177610121492,3,N);
@: 371529140824544191

? X:@
;
@: 371529140824544191

? POWERMOD(X,D,N);
@: 704177610121492

? SYSTEM();
@:

2)PR# 0
```

Listing 9: *The full 101-digit keys used for actually encoding and decoding a number, representing a message.*

```
? LOAD(ENV3);
@:

? P;Q;N;D;
@:
5669682733234183949743401862732403737825
1

? @:
1112245192858508592950635202981592638763
495067113359264305331

? @:
6306077365072611053931059220460476141900
0135895287313649294616210624533300703021
096023498624002756081

? @:
4204051576715074035954039480306984094599
9349100062970093801072585729479577483173
444625171960467381667

? MS:3141592654271828182180123456789987654321017761492106615821983181258
599988877
7666555;
@:
31415926542718281821801234567899876543210
1776149210661582198318125859998887776665
55
```

(continued)

```
? POWERMOD(MS,3,N);
@:
2391917580137497327887542324950723701987
5242707876113408781547556820671025272647
494310831318125653516

? CD:@;
@:
2391917580137497327887542324950723701987
5242707876113408781547556820671025272647
494310831318125653516

? POWERMOD(CD,D,N);
@:
3141592654271828182801234567899876543210
1776149210661582198318125859998887776665
55

? SYSTEM();
@:

2)PR# 0
```

As Smith has mentioned, you can create an electronic "signature" by decoding something first, using your private key, *d*, in POWERMOD (message, *D*,*N*). The recipient, by converting it (cubing) to the original message via POWERMOD (code, 3,*N*), using the known public key, can tell the message must have come from only one person, the one possessing the unknown *d*. ■

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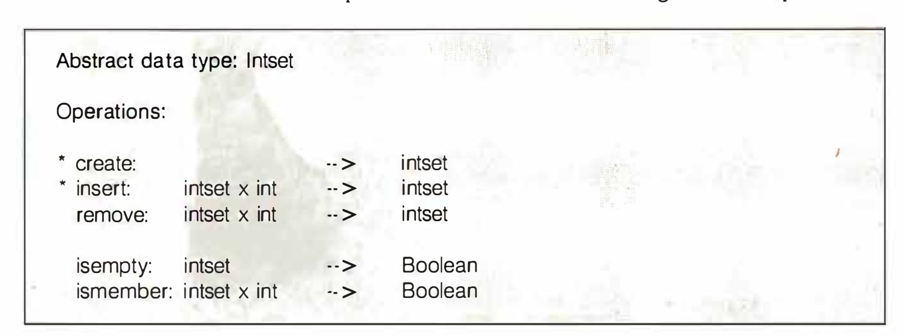
(continued from page 131)

type in terms of an algebra. In the general theory of algebras, an algebra is a pair <A;F>, where *A* is a nonempty set and *F* is a family of operations on *A*. For instance, the familiar algebra of grade school mathematics is defined by the set of real numbers and the operations of addition, subtraction, and so on. Since an abstract data type consists of a set of objects that carry the type and the operations on those objects, it is easy to see how abstract data types lend themselves to definition in terms of an algebra.

The meaning (or the effect) of the operations is defined as a set of formal axioms that state the relationships among the operations. The reduction of the operations' meanings to a set of axioms makes it possible to reason formally about the correctness of a design before it is implemented. This is one of the productive ways of using this approach in program design.

The algebraic approach to specifying abstract data types is rigorously defined by John Guttag and J. J. Horning (see reference 1) and consists of two parts: a syntactic specification and a semantic specification. The syntactic specification defines how the type interfaces with the outside world; it defines the name of the type, the names of all its operations, and the types of the domains (inputs) and ranges (outputs) of the operations. Figure 3 illustrates the syntactic specification for the abstract type intset.

The operations on any data type fall into two classes: generator operations and inquiry operations. The generators are those operations that produce an object of the type of interest (for example, intset). The inquiry operations focus on objects of interest but produce a result that is of a different type (for example, Boolean). The blank line in the example of figure 3 separates the two classes of operators. Within the set of generators there is a subset called basic generators that are sufficient to generate any object of the type of interest. The basic generators, create and insert, are marked in figure 3 with a preceding asterisk.


```
Abstract data type: Intset

Operations:

* create:                  -->   intset
* insert:    intset x int  -->   intset
  remove:    intset x int  -->   intset

  isempty:   intset        -->   Boolean
  ismember:  intset x int  -->   Boolean
```

Figure 3: *Syntactic specification for abstract type* intset.

The semantic specification of the operations consists of a set of axioms that define the meaning of the operations by stating their relationships to one another. The axioms are presented as equations in which the left-hand side specifies an expression to be defined and the right-hand side gives its meaning. For the basic generators, no definitions are written; they are assumed as given. Thus we first write axioms that define the meaning of the nonbasic generators (for example, remove); the right-hand sides of these equations must eventually be reduced to expressions involving only basic generators. Then

(continued)

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we provide axioms that define the meaning of applying each inquiry operation to each of the basic generators. Note that since the meaning of any nonbasic generator can be expressed in terms of basic generators alone, there is no need to write axioms defining the application of inquiry operations to nonbasic generators. Figure 4 gives a sample semantic specification for the type intset. The equal sign used in the axioms is to be read as "means the same thing as."

Note that there are three sets of axioms, one for each nonbasic generator and inquiry operation that must be defined. Each is defined in terms of two axioms, one for each of the two basic generators of the type of interest.

The definition of isempty is easy to understand. If an intset, s, were generated by create, then the set has no members yet, and the expression empty(s) means the same thing as T, or true. If the intset was generated by insert, then the set must have members, and empty means the same thing as F, or false.

Remove and ismember use a basic generator of type Boolean named equal. It tests two integers for equality. In conjunction with this Boolean generator, they use the if-then-else operation that is defined by the following two axioms:

if T then *a* else *b* = *a*
if F then *a* else *b* = *b*

That is, "if T then *a* else *b*" means the same thing as (or, can be reduced to) *a*, and "if F then *a* else *b*" means simply *b*. In other words, if the Boolean condition reduces to true then the whole expression reduces to the *then* clause, otherwise to the *else* clause.

Both remove and ismember are defined recursively, that is, in terms of themselves. For instance, the second axiom for ismember says that if the integer *i* is not equal to the first item in the intset generated by "insert (i',s)", then the expression "ismember(i, insert(i',s))" means the same thing as "ismember(i,s)". We then apply the

(continued)

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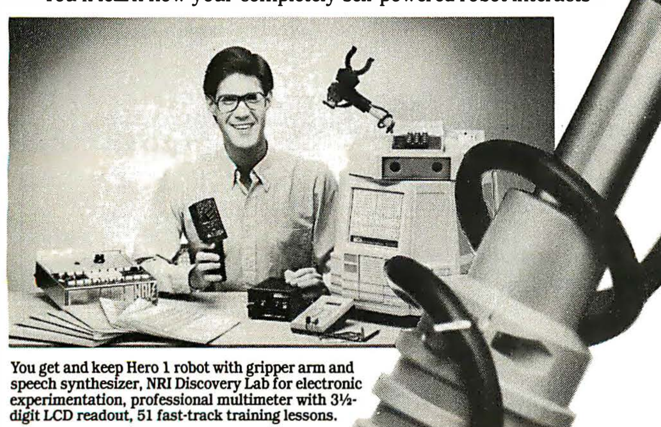
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same axioms to this simplified expression to reduce it ultimately to T or F. The recursive application of the axioms is easily illustrated. For instance, imagine an intset of three members: {1,2,3}. In the language of our axioms, this set would be represented by the expression:

insert(1,insert(2,insert(3,create)))

We now want to test if 4 is a member of the set. This test is equivalent to the expression:

ismember(4,insert(1,insert(2,insert(3,create))))

To discover what this expression means, we simplify it by applying the axioms repeatedly until it can be reduced no further. Figure 5a illustrates this process; we see that the expression ultimately reduces to F, or false. Similarly, we can test if 2 is a member of the set. This is done in figure 5b where we see that the result is T, or true.

These illustrations demonstrate the potential of the method for giving us a rigorous way to reason about the meaning and ultimately the correctness of program designs. The sequences of derivations in figure 5 are actually proofs that "ismember(4,{1,2,3})" means false and that "ismember(2,{1,2,3})" means true. In

(continued)

```
Axioms:
For all i, i' of type Int, and all s of type Intset:

remove(i,create) = create
remove(i,insert(i',s)) = if equal (i,i') then s else insert(i',remove(i,s))

isempty(create) = T
isempty(insert(i,s)) = F

ismember(i,create) = F
ismember(i,insert(i',s)) = if equal(i,i') then T else ismember(i,s)
```

Figure 4: *Semantic specification for abstract type* intset.

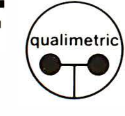
```
(a) Is 4 a member of the set {1,2,3}?

ismember(4,insert(1,insert(2,insert(3,create)))) =
if equal(4,1) then T else ismember(4,insert(2,insert(3,create))) =
if F then T else ismember(4,insert(2,insert(3,create))) =
ismember(4,insert(2,insert(3,create))) =
if equal(4,2) then T else ismember(4,insert(3,create)) =
if F then T else ismember(4,insert(3,create)) =
ismember(4,insert(3,create)) =
if equal(4,3) then T else ismember(4,create) =
if F then T else ismember(4,create) =
ismember(4,create) =
F


(b) Is 2 a member of the set {1,2,3}?

ismember(2,insert(1,insert(2,insert(3,create)))) =
if equal(2,1) then T else ismember(2,insert(2,insert(3,create))) =
if F then T else ismember(2,insert(2,insert(3,create))) =
ismember(2,insert(2,insert(3,create))) =
if equal(2,2) then T else ismember(2,insert(3,create)) =
if T then T else ismember(2,insert(3,create)) =
T
```

Figure 5: *Reducing expressions by axiomatic substitution.*





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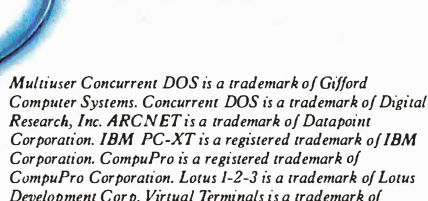
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a formal proof, we would also need to list with each reduction a reference to the axiom used.

These examples should make it clear that the axioms are expressed rigorously enough that a computer could help us in the tedious work of reducing expressions as we reason and test our designs. In fact, the axioms could be implemented directly on a substitution (or reduction) machine as a way of testing the design. Cristoph Hoffman and Michael O'Donnell describe just such a system in their article, "Programming with Equations" (see reference 2). Certainly the specification of data abstractions, whether by formal or informal means, is a powerful new tool for software designers.

Implementing Abstract Data Types in BASIC

We now turn our attention to the practical application of data abstraction by implementing two versions of the intset abstraction in BASIC. BASIC is by no means an ideal language for implementing data abstractions. However, in as much as it is the lingua franca of personal computing, there is perhaps no better way of demonstrating the principles of data abstraction to a general audience. Not only should this exercise illustrate the benefits of the data-abstraction technique, it should also demonstrate that with discipline, a programmer can produce good code in BASIC that is maintainable and portable.

BASIC lacks two things that data abstraction needs: parameterized procedure calls (for invoking the operations) and limited scoping of variables (to support information hiding). Neither shortcoming is insurmountable; both are solved by requiring a more careful use of variables. Unfortunately, this puts a greater responsibility on the programmer than would be required by more modern languages and consequently increases the opportunity for programming errors.

The variables used in a BASIC implementation of an abstract data type fall into three categories: variables used to pass parameters to, and return values from, the operations; variables used in the concrete representation of the abstract type; and variables used locally in the implementation of the operations. Unfortunately, all variables in BASIC have a global scope and so nothing can be used without reference to how it is used elsewhere in the program. The first category of variables defines the user's interface with the operations of the data type. These must be known and understood in order to use the data type. The second and third categories need not be understood by the user, but their names must be known.

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The programmer must know what variables are used in the implementation of the data type, in order to avoid abusing the type by inadvertently using one of these variables for a different purpose elsewhere.

In a pure information-hiding environment this would not be the case. When a data abstraction truly hides the concrete representation of a type, then the way one type is represented cannot interfere with how another is. But in BASIC this does not come automatically since all variables have a global scope and the representation of one type can therefore interfere with another if the variables are not unique. The BASIC programmer must therefore be content with a weaker form of data abstraction that hides the meaning and use of the data structures that implement an abstract type but cannot hide their names.

After an abstract data type has been specified, as discussed in the preceding sections, there are three steps in its implementation: (1) define the user interface, (2) define the concrete representation, and (3) implement the operations. Each of these steps will be considered in turn.

DEFINING THE USER INTERFACE

The user interface refers to what a person must know in order to invoke the operations of the data type. For each operation, the following items must be defined: the line number where the subroutine begins, the variables in which input parameters are passed to the operation, the variables in which values are returned, and the variables in which exception codes are signaled. All of this information can be conveyed in a one-line REM (remark) statement that serves as a header for the subroutine. (The version of BASIC used in the listing below allows ' as shorthand for REM.)

Figure 6 illustrates a possible definition of the user interface for the abstract type intset. Note, for instance, the header for the operation "insert." The address of the subroutine is identified as line 1200. The input parameters (a set identifier and an integer to insert into the set) are passed in the variables *S* and *X* respectively. The operation returns *s* as the set identifier of the resulting set. The operation may signal one of three exception codes; this is done with three variables that return a Boolean value. If one of these variables has a value of true when the subroutine returns, then that condition has occurred. Thus the insert operation may signal "not a valid set" in NS, "not a valid integer" in NI, or "no more room" in NR.

(continued)

Note also that figure 6 defines four new operations on type intset: display, kill, intersect, and union. Display prints the contents of a set on the screen. Kill deletes an existing set. Intersect produces a new set that is the intersection of two existing sets. Union produces a new set that is the combination of two existing sets. These operations provide a fuller environment for testing our implementations of the intset abstraction.

```
1000 'abstract data type: INTSET
1100 'create( ) returns(s) signals(os)
1200 'insert(s,x) returns(s) signals(ns,ni,nr)
1300 'remove(s,x) returns(s) signals(ns,ni)
1400 'isempty(s) returns(b) signals (ns)
1500 'ismember(s,x) returns(b) signals(ns,ni)
1600 'display(s) signals(ns)
1700 'kill(s) signals(ns)
1800 'intersect(s1,s2) returns(s) signals(ns,os)
1900 'union(s1,s2) returns(s) signals (ns,os,nr)

Key to exception codes:

ni = not a valid integer
nr = no more room
ns = not a valid set
os = out of sets
```

Figure 6: *User interface for abstract data type* intset.

Using the Abstract Data Type

With the design of the user interface in hand, we know enough to write a program that uses the type. Figure 7 gives the overall design for a program to test an implementation of intset. (It overlooks the details of what to do when an exception is signaled.) The test program repeatedly takes a one-letter command and two numerical arguments, executes the named operation, and displays the resulting set.

See listing 1 for the test program. As an example of how to use an operation, consider the use of insert in lines 410 and 420. The operation is invoked by GOSUB 1200, but before calling the subroutine we must pass the parameters. The interface requires

(continued)

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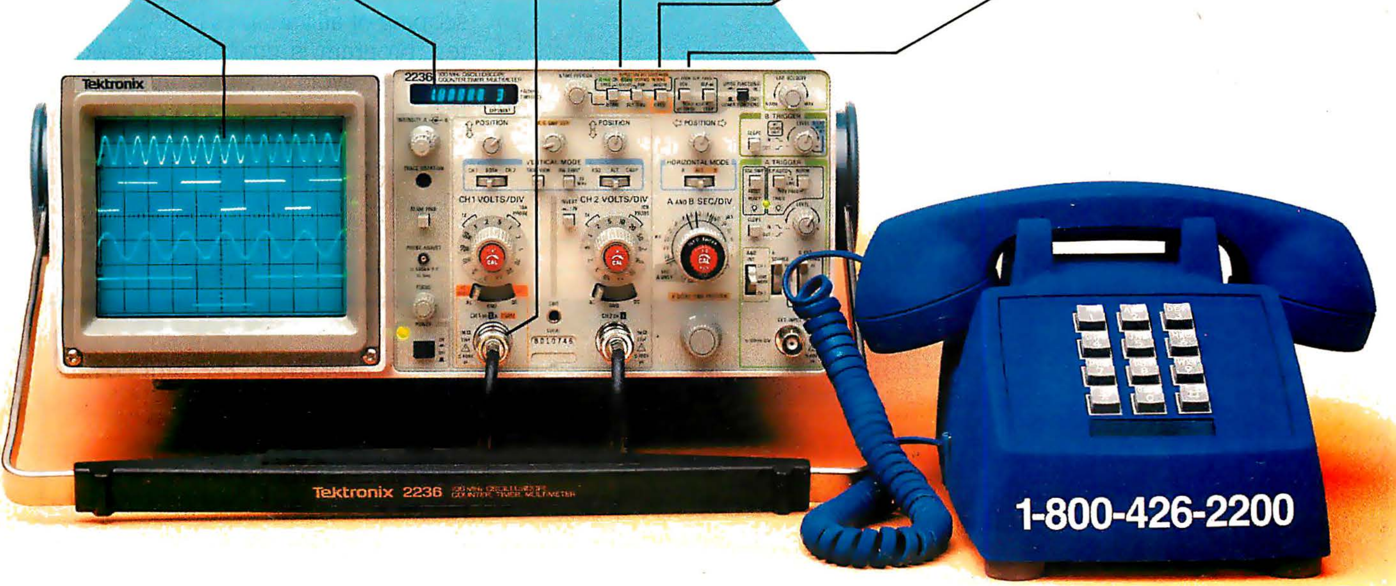
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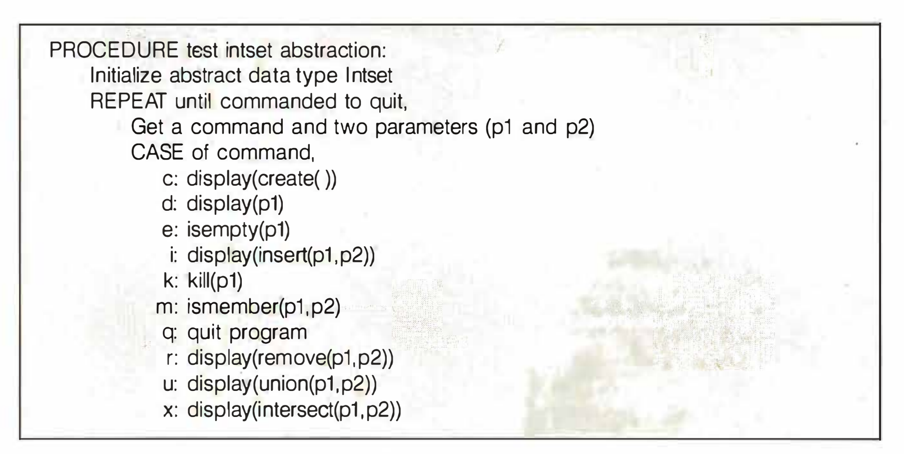
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that the set identifier be passed in S and the integer to insert in X, thus the code: "S = P1: X = P2". In line 420, the statement GOSUB 1600 calls display. This too requires a set identifier in S but since insert returns with the current set in S, there is no need for an assignment statement to pass the parameter. As long as S was not an invalid set identifier, that is, as long as NS = False, we display the resulting contents of set S. It is assumed that all exception conditions will generate an error message when they are discovered by intset. If NI or NR occurs, a message will be given, but we still want to display the current status of S. The use of the other operations follows the same principles.

It is important to note that we were able to write a program using intset before we decided how the type is to be represented or implemented. This is the power of information hiding and data abstraction at work. As long as we stick to the interface definition in figure 6 when we implement the data type, the test program will work.

There is, however, one slight complication brought on by the global scoping of all variables in BASIC. Our test program is guaranteed to work only if we avoid variable conflicts. The test program happens to use three variables of its own that are not part of the intset interface. These are C$, P1, and P2. The test program is



```
PROCEDURE test intset abstraction:
    Initialize abstract data type Intset
    REPEAT until commanded to quit,
        Get a command and two parameters (p1 and p2)
        CASE of command,
            c: display(create( ))
            d: display(p1)
            e: isempty(p1)
             i: display(insert(p1,p2))
            k: kill(p1)
           m: ismember(p1,p2)
            q: quit program
            r: display(remove(p1,p2))
            u: display(union(p1,p2))
            x: display(intersect(p1,p2))
```

Figure 7: *Design for program to test an implementation of* intset.

(continued)

WHAT TO WARE WHILE BALANCING THE BOOKS.

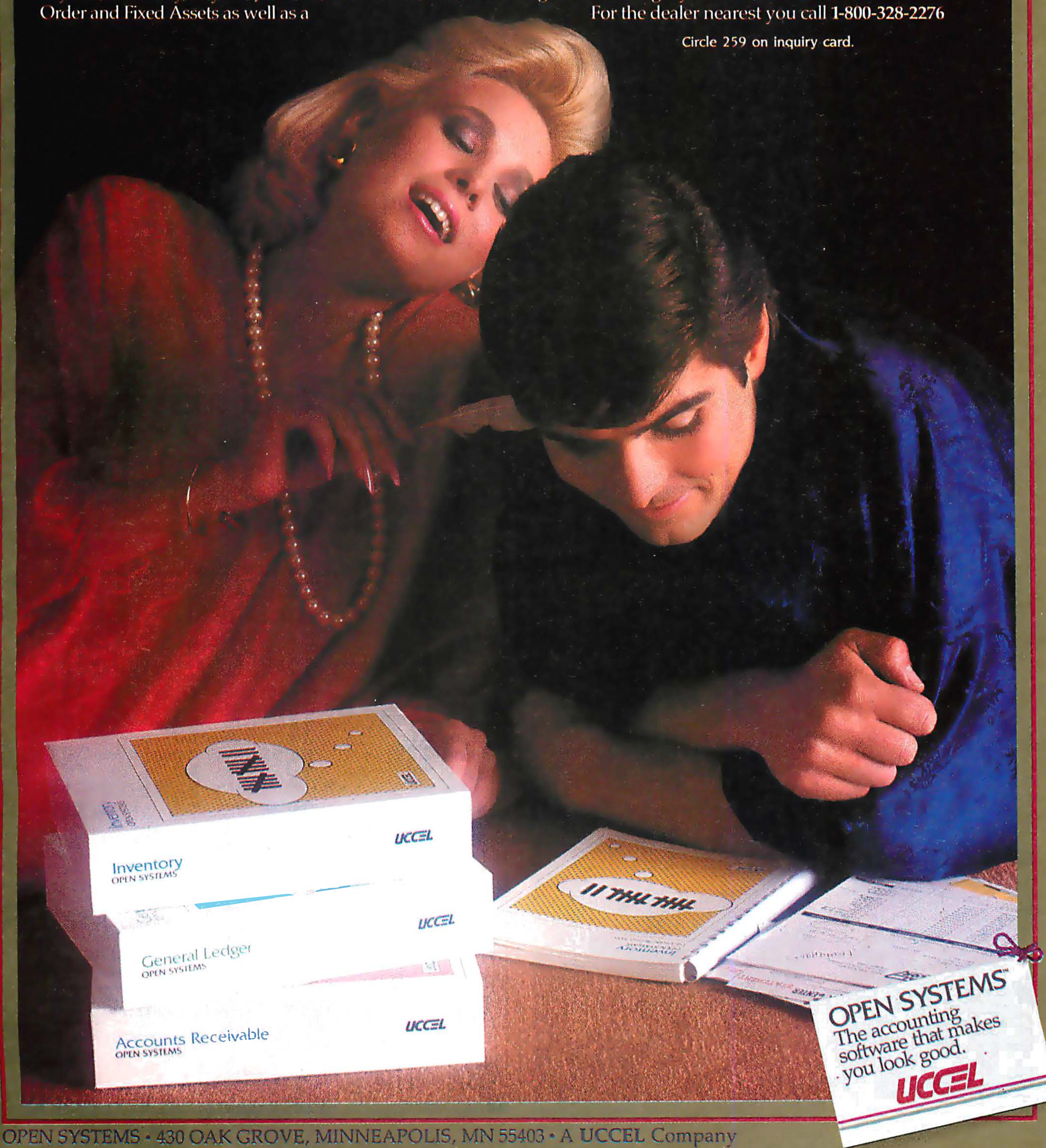
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guaranteed, therefore, only if the implementation of intset stays away from these three variable names. Conversely, if we begin with an already implemented data type and want to write a program that uses it, that program may not use any variable as a free variable that is used in the implementation of the data type.

Defining the Concrete Representation

The second step in implementing an abstract data type is to define the concrete representation. A straightforward representation for integer sets is to store them in a matrix where each row represents a set and the columns hold individual set elements. A value of −1 means that the matrix cell is empty; a positive integer is a set element. A value of −1 in column 0 means that the whole row is unused.

Note that in figure 6, the first operation is not coded until line 1100. The lines between 1000 and 1100 are reserved for comments that describe the concrete representation, followed by an initialization subroutine that sets up the storage space for the data type as required by the method of representation. This subroutine is the first thing called by the test program of listing 1.

Listing 2 gives a full implementation of intset with an underlying matrix representation of 11 sets (in rows 0 to 10) with 10 elements each (in columns 1 to 10). Note lines 1000 to 1040, which are comments describing the method of representation, and lines 1050 to 1080, which define an initialization routine that sets up the storage space for intsets.

Implementing the Operations

Now we are ready for the third step, implementing the operations. The headers defined for the user interface (see figure 6) serve as the first lines for the subroutines that implement each of the operations. Given the representation of the data type and the variables specified in the header for parameter, result, and exception code passing, the implementation of the operations falls into place. See listing 2 for the complete implementation of the operations. Note that the implementation makes use of two private subroutines (at lines 2000 and 2100) for checking the validity of parameters s and x. These do not appear in the list of operations of the data type (figure 6) because they are meant to be used only from within the module, not by outside users.

A new complication presents itself when implementing the operations. That is the problem of local variables. One must ensure that the extra vari-

(continued)

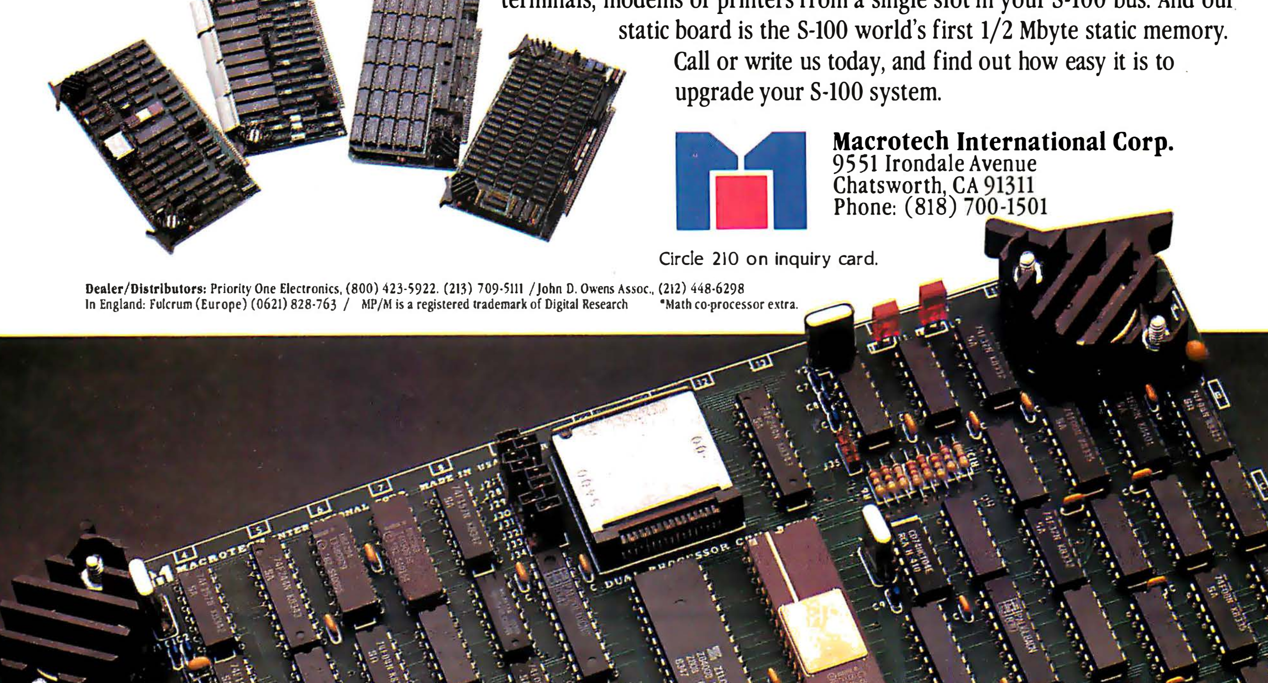
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Listing 1: *Program for testing the* intset *abstraction.*

```
100 GOSUB 1000 'initialize INTSET storage
110 T=-1: F=0 'initialize TRUE and FALSE
200 INPUT C$,P1,P2: IF C$<"a" THEN C$=CHR$(ASC(C$)+32)
250 IF C$="c" THEN 260 ELSE 300
260    GOSUB 1100 'create( )
270    IF NOT OS THEN GOSUB 1600 'display(s)
280    GOTO 200
300 IF C$="d" THEN 310 ELSE 350
310    S=P1: GOSUB 1600 'display(p1)
320    GOTO 200
350 IF C$="e" THEN 360 ELSE 400
360    S=P1: GOSUB 1400 'is-empty(p1)
370    IF NOT NS THEN IF B THEN PRINT "True" ELSE PRINT "False"
380    GOTO 200
400 IF C$="i" THEN 410 ELSE 450
410    S=P1: X=P2: GOSUB 1200 'insert(p1,p2)
420    IF NOT NS THEN GOSUB 1600 'display(s)
430    GOTO 200
450 IF C$="k" THEN 460 ELSE 500
460    S=P1: GOSUB 1700 'kill(p1)
470    IF NOT NS THEN PRINT "Set";S;"deleted"
480    GOTO 200
500 IF C$="m" THEN 510 ELSE 550
510    S=P1: X=P2: GOSUB 1500 'is-member(p1,p2)
520    IF NOT NS AND NOT NI THEN IF B THEN PRINT"True" ELSE PRINT"False"
530    GOTO 200
550 IF C$="q" THEN 560 ELSE 600
560    STOP 'quit program
600 IF C$="r" THEN 610 ELSE 650
610    S=P1: X=P2: GOSUB 1300 'remove(p1,p2)
620    IF NOT NS THEN GOSUB 1600 'display(s)
630    GOTO 200
650 IF C$="u" THEN 660 ELSE 700
660    S1=P1: S2=P2: GOSUB 1900 'union(p1,p2)
670    IF NOT NS AND NOT OS THEN GOSUB 1600 'display(s)
680    GOTO 200
700 IF C$="x" THEN 710 ELSE 750
710    S1=P1: S2=P2: GOSUB 1800 'intersect(p1,p2)
720    IF NOT NS AND NOT OS THEN GOSUB 1600 'display(s)
730    GOTO 200
750 PRINT "Unrecognized command": GOTO 200
```

Listing 2: *Matrix implementation of* intset *abstraction.*

```
1000 'Abstract data type: INTSET
1005 '
1010 'Representation:
1015    'Each row of matrix S(10,10) stores a set. There is thus
1020    'a maximum of 11 sets (numbered 0 to 10). If the 0 element
1025    'of a row is -1, then that set has not been created.
1030    'That leaves columns 1 to 10 for set elements. A cell with
1035    'value -1 is empty; otherwise the cell contains an element
1040    'of the set
1050 'Initialize the INTSET storage:
1060    DIM S(10,10)
1070    FOR I=0 TO 10: FOR J=0 TO 10: S(I,J)=-1: NEXT J,I
1080    RETURN
1095 '
1100 'create( ) returns(s) signals(os) local(i)
1110 'OS=F
```

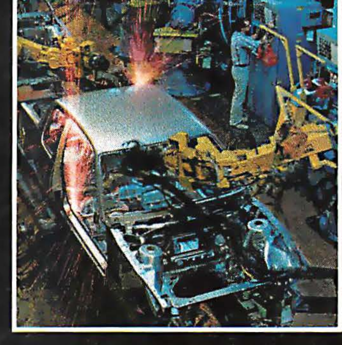
(continued)



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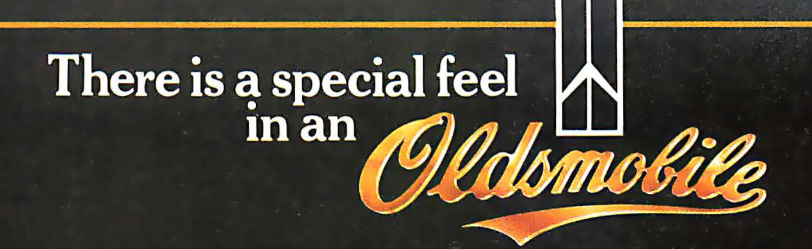
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```
1120 FOR I=0 To 10 'find first unused set
1130   IF S(I,0)=-1 THEN S(I,0)=0: S=I: GOTO 1150
1140 NEXT I: OS=T: PRINT "Out of sets"
1150 RETURN 1195 '
1195 '
1200 'insert(s,x) returns(s) signals(ns,ni,nr) local(i,j)
1210 GOSUB 2000: IF NS THEN RETURN
1220 GOSUB 2100: IF NI THEN RETURN
1230 NR=F: J=0 'J holds first available cell
1240 FOR I=10 TO 1 STEP -1
1250 IF S(S,I)=X THEN RETURN 'no duplicates in a set
1260 IF S(S,I)=-1 THEN J=I
1270 NEXT I
1280 IF J=0 THEN NR=T: PRINT "No more room in set";S: ELSE S(S,J)=X
1290 RETURN
1295 '
1300 'remove(s,x) returns(s) signals(ns) local(i)
1310 GOSUB 2000: IF NS THEN RETURN
1320 GOSUB 2100: IF NI THEN RETURN
1330 FOR I=1 TO 10
1340   IF S(S,I)=X THEN S(S,I)=-1
1350 NEXT I
1360 RETURN
1395 '
1400 'is-empty(s) returns(b) signals(ns) local(i)
1410 GOSUB 2000: IF NS THEN RETURN
1420 B=T
1430 FOR I=1 TO 10
1440   IF S(S,I)>-1 THEN B=F 'test for a used cell
1450 NEXT I
1460 RETURN
1495 '
1500 'is-member(s,x) returns(b) signals(ns) local(i)
1510 GOSUB 2000: IF NS THEN RETURN
1520 GOSUB 2100: IF NI THEN RETURN
1530 B=F
1540 FOR I=1 TO 10
1550   IF S(S,I)=X THEN B=T
1560 NEXT I
1570 RETURN
1595 '
1600 'display(s) signals(ns) local(i)
1610 GOSUB 2000: IF NS THEN RETURN
1620 PRINT "Set";S;": {";
1630 FOR I=1 TO 10: IF S(S,I)<>-1 THEN PRINT S(S,I);
1640 NEXT I: PRINT "}"
1650 RETURN
1695 '
1700 'kill(s) signals(ns) local(i)
1710 GOSUB 2000: IF NS THEN RETURN
1720 FOR I=0 TO 10
1730   S(S,I)=-1 'every cell becomes unused
1740 NEXT I
1750 RETURN
1795 '
1800 'intersect(s1,s2) returns(s) signals(ns,os) local(i,j,k)
1810 S=S1: GOSUB 2000: IF NS THEN RETURN
1815 S=S2: GOSUB 2000: IF NS THEN RETURN
1820 GOSUB 1100: S3=S: IF OS THEN RETURN 'create new set for result
1830 FOR K=1 TO 10
1840   IF S(S1,K)=-1 THEN 1860 'for each member of first set,
1850   X=S(S1,K): S=S2: GOSUB 1500 'if it is a member of second set,
1855   IF B THEN S=S3: GOSUB 1200 'then insert into result
1860 NEXT K
```

(continued)

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```
1870 S=S3: RETURN
1895 '
1900 'union(s1,s2) returns(s) signals(ns,os,nr) local (i,j,k)
1910 S=S1: GOSUB 2000: IF NS THEN RETURN
1915 S=S2: GOSUB 2000: IF NS THEN RETURN
1920 GOSUB 1100: S3=S: IF OS THEN RETURN 'create new set for result
1930 FOR I=1 TO 10
1935    S(S3,I)=S(S1,I) 'copy first set into result
1940 NEXT I
1950 FOR K=1 TO 10
1960    IF S(S2,K)=-1 THEN 1980 'for each member of second set,
1970    S=S3: X=S(S2,K): GOSUB 1200 'insert it into result
1975    IF NR THEN 1990
1980 NEXT K
1990 RETURN
1995 '
2000 'is-valid-set(s) return(ns)
2010 IF S<0 OR S>10 THEN NS=T: PRINT S;"not a valid set number": RETURN
2020 IF S(S,0)=-1 THEN NS=T: PRINT "Set";S;"not created yet": RETURN
2030 NS=F: RETURN
2095 '
2100 'is-not-integer(x) returns(ni)
2110 IF X<0 OR X< >INT(X) THEN NI=T:PRINT X;"not a valid integer";RETURN
2120 NI=F:RETURN
```

ables used (that is, those not part of the concrete representation or the user interface) do not conflict with those used elsewhere, whether in another abstraction, the calling procedure, or in other operations of the same data type. For this reason it is advisable to add one more item of information to the header for each operation, namely, a list of the additional local variables that it uses. Note that this is done in listing 2.

The local variables are ones that the operations use temporarily. Whatever value they may have had previously is destroyed. When a subroutine returns, their value is undefined and they are free to be used again. Keeping track of local variables becomes tricky (and imperative) when one operation calls another. The implementation of intersect (line 1800 and following) is a case in point. One

(continued)



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Data abstraction allows you to modify a program simply by changing a module's implementation.

would be tempted to use I as the local indexing variable as is done in all other operations. However, intersect calls insert (line 1200 and following), which already uses I and J as local variables; we see this by looking at the *local* statement in the header of insert. This alerts us to the fact that if we use I in intersect we are in for trouble; every call to insert would destroy its value. Thus, we use a new variable, K. Note also that the local variables for intersect are given as I, J, and K, even though I and J do not appear in the code for the intersect operation. This is because a procedure always inherits the local variables of any procedure it calls.

Maintenance and Portability

From the perspective of the program code that is outside an abstract data type, we have already seen that an advantage of programming with data abstractions is that you can write programs that use them without knowing how they are implemented on the inside. Now we take the perspective of the program code inside the abstract data type and see that an advantage of programming with data abstractions is that you can modify the implementation without affecting the outside programs that use it. This is a boon for maintaining a program and porting it to other systems.

For instance, suppose we decided that limiting our sets to a maximum of 10 elements (as does the implementation of listing 2) is too restricting. We decide we want to modify our program to allow for sets of up to 20 elements. Because the information about how the intset abstraction is represented is hidden inside the intset module, any programs that use the abstraction (in this case the test program of listing 1) are not affected. The only changes to make include redefining the matrix dimensions in the initialization procedure (lines 1050–1080) and changing the upper bound of the FOR statements in all the subroutines for the operations. We soon discover that this latter change gets rather tedious and that we would have been better off in the first place to make the maximum size of a set a variable in the concrete representation of intset, and then to use that variable in the FOR loops for all the subroutines. Then changing the maximum size of sets would mean chang-

(continued)

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ing only one assignment statement in the concrete representation of the data type. In any case, all program modifications are confined to the intset module.

Unfilled sets waste space, and increasing the size of the matrix to accommodate potentially larger sets has the disadvantage of wasting even more space. One solution is to represent an intset as a linked list of elements so that the set never uses more memory than it needs. With such a scheme, the maximum length of a set depends on the total length of all other sets, rather than a fixed limit for each set.

Normally such a change would require a complete rewrite. When data abstraction is used, it means replacing only the implementation of the intset module; the programs that use intset change in no way. As an example, listing 3 gives a completely new implementation of the intset abstraction using a linked-list representation. This implementation adheres

(continued)

Listing 3: *Linked list implementation of* intset *abstraction.*

```
1000 'Abstract data type: INTSET
1005 '
1010 'Representation:
1015      ' ST(10) is the "Set Table"
1020           'ST(I) specifies the address in S of the first element of set I
1025           'ST(I) =- 1 means set I not yet created
1030      'S(100,1) stores the set elements
1035           'Column 0 stores a set element
1040           'Column 1 is link which specifies address in S of next element
1045           'Column 0 value of -1 marks end of list (and of set)
1050      'A points to next available cell of S
1055           'Initially all cells of S are linked together on available list
1060 'Initialize the INTSET storage:
1065      DIM ST(10): FOR I=0 TO 10: ST(I)=-1: NEXT I
1070      DIM S(100,1): FOR I=0 TO 99: S(I,1)=I+1: NEXT I 'link all cells
1075      S(100,0)=-1: A=0 'put entire list of cells on available list
1080      RETURN
1095 '
1100 'create( ) returns(s) signals (os) local(i,n)
1110 OS=F
1120 FOR I=0 TO 10
1130      IF ST(I)=-1 THEN 1150 'find first unused set
1140 NEXT I: OS=T: PRINT "Out of sets": RETURN 'fail with OS if none
1150 GOSUB 2200: IF NR THEN OS=T: RETURN 'or if no more room
1160 ST(I)=N: S(N,0)=-1: S=I: RETURN 'initialize set
1195 '
1200 'insert(s,x) returns(s) signals(ns,ni,nr) local(i,n)
1210 GOSUB 2000: IF NS THEN RETURN
1220 GOSUB 2100: IF NI THEN RETURN
1230 GOSUB 1500: IF B THEN RETURN 'no duplicates
1240 GOSUB 2200: IF NR THEN RETURN
1250 S(N,1)=ST(S): ST(S)=N S(N,0)=X 'insert the element
1260 RETURN
1295 '
1300 'remove(s,x) returns(s) signals(ns,ni) local(i,j)
1310 GOSUB 2000: IF NS THEN RETURN
1320 GOSUB 2100: IF NI THEN RETURN
1330 I=ST(S): J=0 'J will point to cell preceeding one to remove
1340 IF S(I,0)=-1 THEN RETURN
1350      IF S(I,0)<>X THEN J=I: I=S(I,1): GOTO 1340 'find element to remove
1360 IF J=0 THEN ST(S)=S(I,1) ELSE S(J,1)=S(I,1) 'remove it
1370 S(I,1)=A: A=I 'return removed cell to available list
1380 RETURN
1395 '
1400 'is-empty(s) returns(b) signals(ns)
```

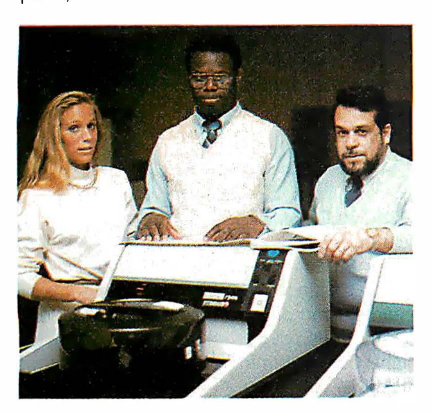
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```
1410 GOSUB 2000: IF NS THEN RETURN
1420 IF S(ST(S),0)=-1 THEN B=T ELSE B=F
1430 RETURN
1495 '
1500 'is-member(s,x) returns(b) signals(ns,ni) local(i)
1510 GOSUB 2000: IF NS THEN RETURN
1520 GOSUB 2100: IF NI THEN RETURN
1530 I=ST(S)
1540 IF S(I,0)=-1 THEN B=F: RETURN 'end of set, not found
1550      IF S(I,0)<>X THEN I=S(I,1): GOTO 1540 'not yet, keep looking
1560 B=T: RETURN 'it is found
1595 '
1600 'display(s) signals(ns) local(i)
1610 GOSUB 2000: IF NS THEN RETURN
1620 PRINT "Set";S;" = {";
1630 I=ST(S)
1640 IF S(I,0)=-1 THEN 1660
1650      PRINT S(I,0);: I=S(I,1): GOTO 1640
1660 PRINT " }": RETURN
1695 '
1700 'kill(s) signals(ns) local(i)
1710 GOSUB 2000: IF NS THEN RETURN
1720 I=ST(S)
1730 IF S(I,0)<>-1 THEN I=S(I,1): GOTO 1730 'find end of set
1740 S(I,0)=0: S(I,1)=A: A=ST(S) 'return cells to available list
1750 ST(S)=-1: RETURN 'mark ST entry unused
1795 '
1800 'intersect(s1,s2) returns(s) signals(ns,os) local(i,j,n)
1810 S=S1: GOSUB 2000: IF NS THEN RETURN
1815 S=S2: GOSUB 2000: IF NS THEN RETURN
1820 GOSUB 1100: S3=S: IF OS THEN RETURN 'create a new set for result
1830 J=ST(S1)
1840 IF S(J,0)=-1 THEN 1870
1850      X=S(J,0): S=S2: GOSUB 1500 'if a member of S1 is in S2,
1855      IF B THEN S=S3: GOSUB 1200:IF NR THEN 1870 'then insert in result
1860      J=S(J,1): GOTO 1840
1870 S=S3: RETURN
1895 '
1900 'union(s1,s2) returns(s) signals(ns,os,nr) local(i,j,n)
1910 S=S1: GOSUB 2000: IF NS THEN RETURN
1915 S=S2: GOSUB 2000: IF NS THEN RETURN
1920 GOSUB 1100: S3=S: IF OS THEN RETURN 'create a new set for result
1930 J=ST(S1) 'insert every element of S1 into result
1940 IF S(J,0)=-1 THEN 1960
1945      X=S(J,0): S=S3: GOSUB 1200: IF NR THEN 1990
1950      J=S(J,1): GOTO 1940
1960 J=ST(S2) 'insert every element of S2 into result
1970 IF S(J,0)=-1 THEN 1990
1975      X=S(J,0): S=S3: GOSUB 1200: IF NR THEN 1990
1980      J=S(J,1): GOTO 1970
1990 S=S3: RETURN
1995 '
2000 'is-not-set(s) returns(ns)
2010 IF S<0 OR S>10 THEN NS=T: PRINT S;"not a valid set number": RETURN
2020 IF ST(S)=-1 THEN NS=T: PRINT "Set";S;"not created yet": RETURN
2030 NS=F: RETURN
2095 '
2100 'is-not-integer(x) returns(ni)
2110 IF X<0 OR X<>INT(X) THEN NI=T:PRINT X;"not a valid integer":RETURN
2120 NI=F: RETURN
2195 '
2200 'get-next-cell( ) returns(n) signals(nr)
2210 IF S(A,0)=-1 THEN PRINT "No more room": NR=T: RETURN
2220 N=A: A=S(A,1): NR=F: RETURN
```

to the interface of figure 6 and therefore is equivalent to the matrix implementation in its external effects. The test program works equally well, whether one combines it with the intset module of listing 2 or the module of listing 3.

Since nearly any two implementations of BASIC differ in some details, BASIC programs turn out to be of limited portability in actual practice. Writing software in terms of data abstractions is an excellent way to enhance a program's ultimate portability. Information hiding localizes the details of implementation that are likely to be changed, such as variable names, matrix dimensions, and input/output protocols.

Passing parameters with assignment statements and calling GOSUB in most lines of a program can get tedious. It may often seem justifiable on the grounds of efficiency to access a data structure directly without going through the operations. You should avoid such temptations at all costs: you'll pay the price when it comes time to debug, enhance, or port the program. ■

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(continued from page 129)

ficiently large (compared with the segment length, m), the mapping will take the point out of the current segment at each jump. The successive positions of the point within each segment will then be an erratic function. You can consider these successive positions pseudorandom numbers if you suppose each segment is renumbered from 0 to $m-1$, as in figure 2.

You can accomplish such a subdivision of the I-space by introducing the modulus function

$$\text{mod}(I,m) = I - |I/m|m$$

where $|I/m|$ is the integer part of the quotient, derived by truncation. When, for example, mod(11,3) = 2, the result always lies between 0 and $m-1$. In some forms of BASIC, this is written 11 MOD 3.

Now rewrite the mapping as

$$I_{i+1} = \text{mod}\ (aI_i + c,m)$$

This equation is a general form for the LCG, and it produces a series of integers in the range $0 < I_i < m-1$. Three parameters describe this mapping: the multiplier (a), the difference (c), and the modulus (m).

Often it is convenient to "normalize" the values, dividing each by the modulus. The result is a series in the range 0 to $(m-1)/m < 1$, which can be written as

$$x_{i+1} = \text{FLOAT}(I_{i+1})\ /\text{FLOAT}(m)$$

Note that the smallest nonzero difference between terms is $1/m$, which means the numbers the LCG produces comprise a set of m equally spaced rational fractions in the range $0 \leq x \leq (m-1)/m$.

To see some of the properties of series that are generated this way, look at the following series:

$$I_{i+1} = \text{mod}\ (5I_i + 3,\ 8)$$

By starting with an arbitrary value, the "seed," and taking $I_1 = 1$, you find 1, 0, 3, 2, 5, 4, 7, 6, 1, 0, 3, 2, 5, ...

This series starts off with a haphazard appearance, but since it repeats itself every 8 terms, it is said to have a "period" of 8. It is not hard to see why this is the period. First, the modulus of the series is 8, so the series cannot have more than 8 integers. (You remove larger integers by subtracting the modulus.) Second, the series is deterministic. Each appearance of a particular integer must be followed by a uniquely determined integer. That is, each appearance of "2" must be followed by "5." As a result, the series must repeat itself with a period no longer than its modulus.

This reasoning suggests adopting a large modulus if you want a long period. But it isn't the only possibility. Some generators will skip many of the possible numbers and give an in-

(continued)

FIND

NEXT RECORD

PREVIOUS RECORD

DELETE

SAVE

SUPERFIND

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NEXT WINDOW

HELP

DELETE CHARACTER

CURSOR LEFT

BACK WINDOW

CALCULATE

CURSOR RIGHT

INSERT CHARACTER

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complete set of "random" numbers. A series that generates all of the m distinct integers ($0 < n < m-1$) during each period is called a "full period." Whether a series will have a full period or not depends in large measure on the values you choose for the parameters (a,c,m). Table 1 illustrates some of the series with $a = 5$ and $m = 8$ for various values of the additive constant, c. Take the first series as an example. If you use a seed, 6, you obtain the pseudorandom series 6, 7, 4, 5, 2, ... If you use the seed 5, you get 5, 2, 3, 0, 1, 6, ...

Because several of the series in table 1 do not have a full period, they generate subsets of integers with many useful properties. In the first place, the sum of the periods of the subsets equals the modulus of the series. This property helps you decide whether you have found all the subsets. Second, if the series does not have a full period, different seeds start each subset. For example, the series with $c = 4$ has six subseries of periods 1 or 2, and the seed you use will determine which subseries you generate.

When you set up a random-number generator, look for a long and full period because it will produce the richest set of numbers. Several established rules for selecting the parameters will achieve a full period. These rules are discussed in Donald Knuth's *The Art of Computer Programming*, referenced at the end of this article. One rule is that the modulus, m, and the constant, c, must have no factors in common. Another rule is that a must be greater than the square root of m ($a > \sqrt{m}$) to avoid the serial correlation that upward runs produce. (This rule ensures that the mapping quickly takes the number out of the current segment, the same condition mentioned earlier.) Finally, you will get the longest possible periods if the modulus is a prime number equal to or less than the largest integer your computer can handle. (For a 16-bit processor, this condition implies that $m \leq 32{,}768$.)

Two additional examples of LCGs with short, full periods follow:

$$I_{i+1} = \text{mod}(7I_i + 5,9)$$

$$I_{i+1} = \text{mod}(7I_i + 7,9)$$

In practice, you develop a pseudorandom-number generator in a cut-and-try process, testing and modifying various possibilities.

In describing the LCG, I assumed that the coefficients were all integers. You can increase the series' apparent period by taking real (decimal) values. For example, if you substitute 5.1 and 3.111 for the coefficients in the series above, the terms won't repeat precisely after a period of eight terms. But the terms in successive cycles will

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show only a slight shift, and the overall pattern of the cycle will be the same—except for occasional jumps when the fractional parts accumulate sufficiently. Thus, the increase of period is only illusory, and, since I don't want to fool you with this illusion, I will restrict myself to integer coefficients.

STATISTICAL TESTS FOR RANDOMNESS

Often, you can look at a series and see that it was probably not generated by a random process. For example, who would claim that a real coin would lead to a series of heads (H) and tails (T) such as HTHHTTHHHTTTHHHHTTTTHHHHHTTTTT? It could happen (with a probability of about $(1/2)^{29} = 0.000000001$), but you wouldn't expect it in your lifetime.

But some series are not so obvious, and you need a more reliable test than the eyeball and a hunch. For this, you must compare some statistical properties of the series with some theoretical predictions you make after assuming that the series was generated by a truly random process. When I refer to a statistical property, I'm talking about one that is independent of the seed you used to start the series, including those tests that are oblivious to the order of terms in the series. (The mean value is one such property.) These statistical tests reveal how likely it is that a random process generated a certain series.

No statistical test is a sure bet, and few tests are reliable in themselves. Some pseudorandom series will pass one test with flying colors, only to fail miserably in another. Therefore, you have to apply several different tests. I will apply some tests to the LCG and the generator that the IBM PC's Advanced BASIC supplies. Then I'll discuss how to develop a more powerful random-number generator that anyone can use.

Let's start with the simplest test: determining the period of the series.

THE CHI-SQUARE TEST

This test is commonly used for agreement between a series of observed values, O_i, and expected values, E_i. In this case, the "observations" are the actual bin populations listed in table 2, and the expected value is the average 1000/100 = 10. There are $n = 100$ observations, and because $n >> 1$, the test can be expressed in a simplified form, as follows. For each bin compute the difference, $O_i - E_i$; square these values, divide by the corresponding value of E_i, and sum the quotients over all the observations. Divide the result by the number of observations, obtaining

$$X^2 = (1/n)\Sigma\ (O_i - E_i)^2/E_i$$

If this quantity lies between 0.5 and 2.0, the scatter of the observations is consistent with random numbers. If $X^2 < 0.5$, the observations are suspiciously close to average values; if $X^2 > 2.0$, they are too far from the average. This test is applicable only to quantities that are expected to obey the classic law of errors—and this is often a debatable point. For the numbers in table 2, $X^2 = 0.79$; therefore, the populations have the properties of random numbers.

PERIOD

You can determine a period by noting a series' first number and then stepping through it while computing one number after another until the first number recurs, that is, until $x_n = x_1$. Then $n-1$ is the period of the series. (In order to ensure that x_n is, indeed, the start of a repeat cycle, the first few values, $x_1 - x_{1+i}$, can be saved for comparison with $x_n - x_{n+i}$.)

Figure 3 shows the unfortunate effect of a short period on the random

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walk generated by one of the LCGs in table 1. You can easily spot the periodicity, and you wouldn't want it as the imitation of a very long random walk. (This walk was generated from a normalized LCG by stepping upward if $x > 0.5$ and downward if $x < 0.5$.)

When I applied this test to the pseudorandom-number generator supplied with the Advanced BASIC Interpreter of the IBM Personal Computer (PC), it showed a period of 65,535. This result was as good as I could have hoped, but a detailed plot of a walk shows that it also has a much shorter wave-like cycle superposed. Figure 4 shows such a plot and reveals a subcycle that is about 18,000 steps long.

DISTRIBUTION

A random sequence ought to contain representative numbers from all parts of the permitted range. Some programs generate numbers that follow

(continued)

Table 1: *Because several of these series do not have a full period, they generate subsets of integers with several useful properties, for example, the sum of the periods of the subsets equals the modulus of the series.*

Linear Congruential Generators, $I_{i+1} = \text{mod}(5I_i + c, 8)$

Expression	I_i	Period
5I + 1	1, 6, 7, 4, 5, 2, 3, 0	8
	1, 7, 5, 3, 1, 7, 5, 3	4
5I + 2	4, 6, 0, 2, 4, 6, 0, 2	4
5I + 3	1, 0, 3, 2, 5, 4, 7, 6	8
	1, 1, 1, 1, 1, 1, 1, 1	1
	2, 6, 2, 6, 2, 6, 2, 6	2
	3, 3, 3, 3, 3, 3, 3, 3	1
5I + 4	4, 0, 4, 0, 4, 0, 4, 0	2
	5, 5, 5, 5, 5, 5, 5, 5	1
	7, 7, 7, 7, 7, 7, 7, 7	1
5I + 5	1, 2, 7, 0, 5, 6, 3, 4	8
	1, 3, 5, 7, 1, 3, 5, 7	4
5I + 6	2, 0, 6, 4, 2, 0, 6, 4	4
5I + 7	1, 4, 3, 6, 5, 0, 7, 2	8

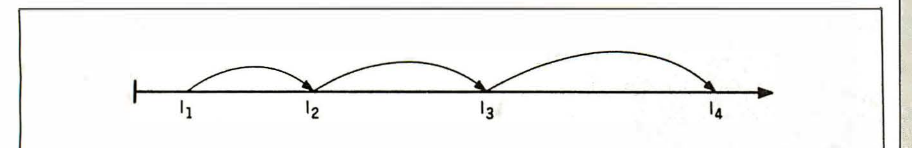


Figure 1: *Schematic diagram of mapping in a linear congruential generator (LCG). Each successive term in the series is larger than the preceding. This series does not imitate a random series, but it is the first step in that direction. See figure 2.*

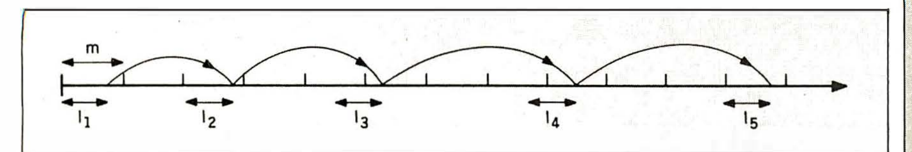


Figure 2: *Schematic of an LCG, showing how the division of the number line into equal intervals, m, can produce pseudorandom numbers. The location of each number inside the corresponding interval is haphazard. It results from using the modulus function and leads to a pseudorandom series.*

special distribution laws (the normal distribution, for example), but I will consider only the ones that are intended to produce uniformly distributed numbers. If I normalize an LCG, my program should produce numbers in the range 0 to 1.0 with equal probability. However, the numbers won't arrive in a perfectly uniform way. They will exhibit a tendency to clump, just as the flips of a real coin will show runs of more than one head or tail instead of HTHTHT.

(continued)

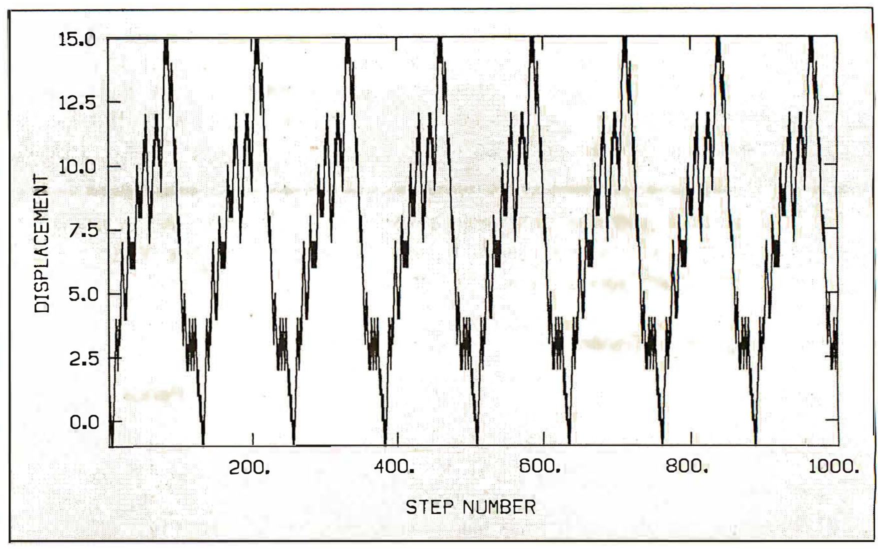


Figure 3: *A random walk generated with a pseudorandom-number generator of the type in table 1, with a period of 127. Each step upward or downward was determined by simulated flip of a coin. This diagram illustrates the repetitive pattern of some random-number generators.*

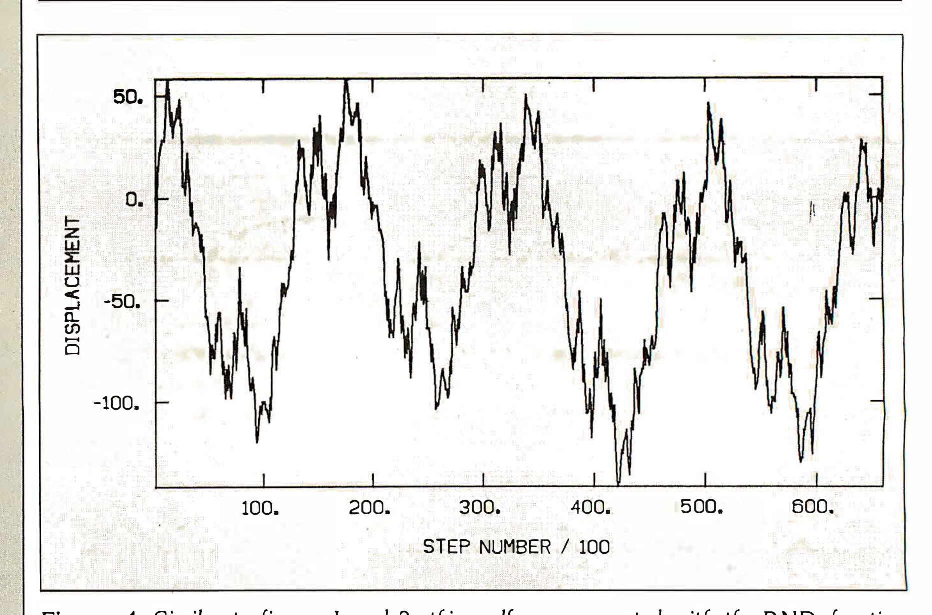


Figure 4: *Similar to figures 1 and 2, this walk was generated with the* RND *function of the* Microsoft Advanced BASIC *supplied with the* IBM PC *operating under* MS-DOS 2.0. *It shows an approximate periodicity of about* 18,000 *steps, although the rigorous period is about* 64,000. *Using such a function for Monte Carlo simulations requiring more than* 8000 *steps could produce misleading results.*

Table 2: *Sample bin populations; the results for N* = 1000 *numbers in* 100 *bins computed with the* BASICA RND. *The observed values cluster about the expected mean,* $<NB> = N/Q = 10$.

Sample Bin Populations with BASICA RND

7	12	17	9	10	12	7	10	11	12
8	13	9	12	12	9	9	11	11	15
9	10	9	11	10	8	9	10	9	8
11	8	13	8	10	11	11	10	17	11
6	9	12	9	8	14	9	10	13	17
9	5	18	10	9	12	9	9	13	10
12	9	6	7	8	5	6	12	6	11
6	7	9	11	9	7	13	7	9	11
9	6	7	5	15	6	12	8	12	19
12	11	12	8	10	8	9	10	12	8

You can test the distribution of numbers by setting up *Q* bins and putting each member of the series into one of the bins. For example, if the numbers are restricted to the interval $0 < x_i < 1$, each can be put into bin *J*, where *J* is computed from

$$J = \text{int}(Q \times x_i),\ 0 < J < Q-1$$

On each occurrence of *J*, the bin count, *NB(J)*, is incremented, so that $NB(J) = NB(J) + 1$.

Table 2 shows the result for *N* = 1000 numbers in 100 bins computed with the BASICA RND. The observed values cluster about the expected mean, $<NB> = N/Q = 10$. When you run the test several times, the excesses and deficiencies appear in different bins. As a result, no evidence appears that any particular bins consistently receive more than *1/Q* of the counts.

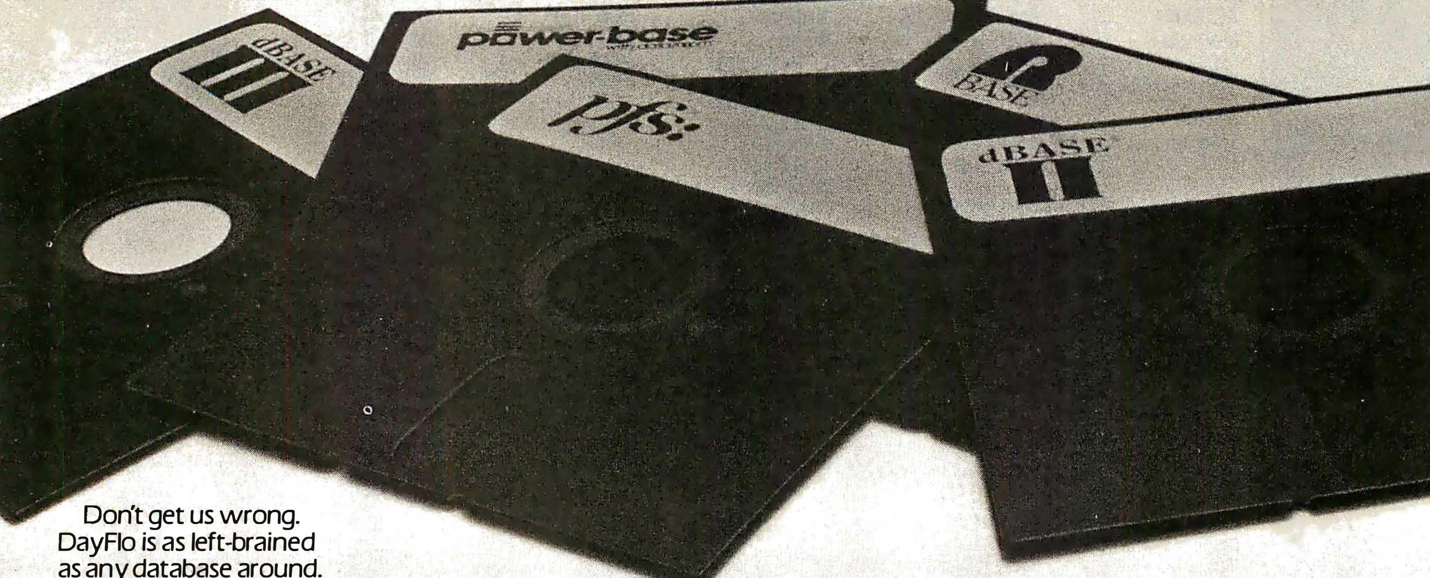
A quantitative measure of performance is the conventional chi-square test, which evaluates a measure of the spread (see "The Chi-Square Test" on page 446). This test estimates how likely it is that the actual value will be different from the expected value in a randomly generated series. If you look at table 2, you find no bins with less than 5, two bins with *NB* = 5, seven with *NB* = 6, and so on. The chi-square test examines all the bin populations and tells how often you can expect this particular distribution of populations from a randomly generated series, where you expect *NB* = 10 on the average.

Applying the chi-square test to the bin populations of table 2 and then for much longer runs using the BASICA generator, you will find that if the random-number generator is pushed to 30,000 terms, it still performs well. The story changes as soon as you get close to the full period of about 65,000 terms. There, all bins are more or less equally filled and the histogram of bin populations, *NB(J)*, becomes tightly peaked about the mean value, $<NB>$, because all possible values have been achieved. The generator has displayed its entire full period. Near this extreme limit, the generator fails the chi-square test because the chances are small that actual values will be any different from the expected value.

What happens when a random-number generator comes to the end of its period is similar to what happens in a game of blackjack when the cards are not collected into the deck after each hand. When 51 cards have been laid out, there is no doubt what the next card will be. You pro-

(continued)

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• No word processing capabilities.	• Integral word processing. Create and store letters, memos, notes, ideas, etc.
• Fixed field length.	• Variable field length. No counting character spaces.
• Adding new fields requires remapping or reformatting of database.	• Instantly add new fields to existing records without reformatting the entire database.
• One value per field.	• Multiple values per field. Information where you want it.
• Retrieves data based on pre-planned criteria only.	• Retrieves information based on content or key words.

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The upshot is that you can probably use a generator out to one-half of its period. For small simulations this limit should be good enough.

AMPLITUDE SPECTRUM FROM FOURIER TRANSFORM

I've already remarked that the random-walk pattern in figure 4, generated from BASICA RND, shows clear signs of waves. The Fourier amplitude spectrum lets you quantitatively measure the waves' size (see "Fourier Spectrum" on page 464). You can derive this spectrum from the fundamental definition of the Fourier coefficients that you'll find in introductory books on applied mathematics. Or you can derive it from the fast Fourier transform subroutines in some software packages. As an example, figure 5 shows the frequency spectrum of the random walk in figure 3, which was generated with an LCG with a period of 127. This spectrum shows the relative amplitudes of waves of various frequencies. You plot the frequencies in terms of the walk's full length, namely 1000 steps, so that the primary period of 127 shows as a peak in the spectrum at about 8 cycles (1000/127) on this spectrum. Because it quickly becomes repetitious, you can't use such an LCG for simulations involving more than a few dozen steps, and the Fourier spectrum puts you on your guard. Figure 6 shows the amplitude spectrum for the BASICA RND pseudorandom-number generator that comes with

the IBM PC's MS-DOS 2.0 operating system. In this diagram, the frequency is the number of peaks in every 64,000-step run. For example, significant waves show 4, 12, 21, 28, and 37 peaks per 64,000 steps. The most prominent is the wave with frequency 4, which accounts for the main random-walk plot pattern. The fact that you can divide two of the higher frequencies, 12 and 28, by 4 accounts for the repeated pattern of details on the waves. This test is a clear call for caution in using BASICA RND, and it implies that you need an improved generator.

SHUFFLING A GENERATOR

How can you extend the period? As mentioned earlier, an LCG's period has two limitations: only integers less than the modulus, *m*, are generated; and the series is deterministic, meaning a particular number always has a particular sequel. For a computer capable of handling integers smaller than a fixed limit, I_{max}, you can do nothing about the first restriction. You can, however, alleviate the second restriction and alter the simple determinism of the series using a technique called "shuffling."

Consider an LCG with a period of 8. Each member of the series is an integer from 0 to 7, and if the selection is purely sequential, the period inevitably will be 8. But suppose you set up a secondary list of five numbers and use a second LCG to select the next member of the series from one of them. Then, after each five selections, you replace the five numbers in the secondary list with a randomly selected set. By using two LCGs, you can shuffle the series and extend the effective period. You do not increase the possible integers but prevent an

(continued)

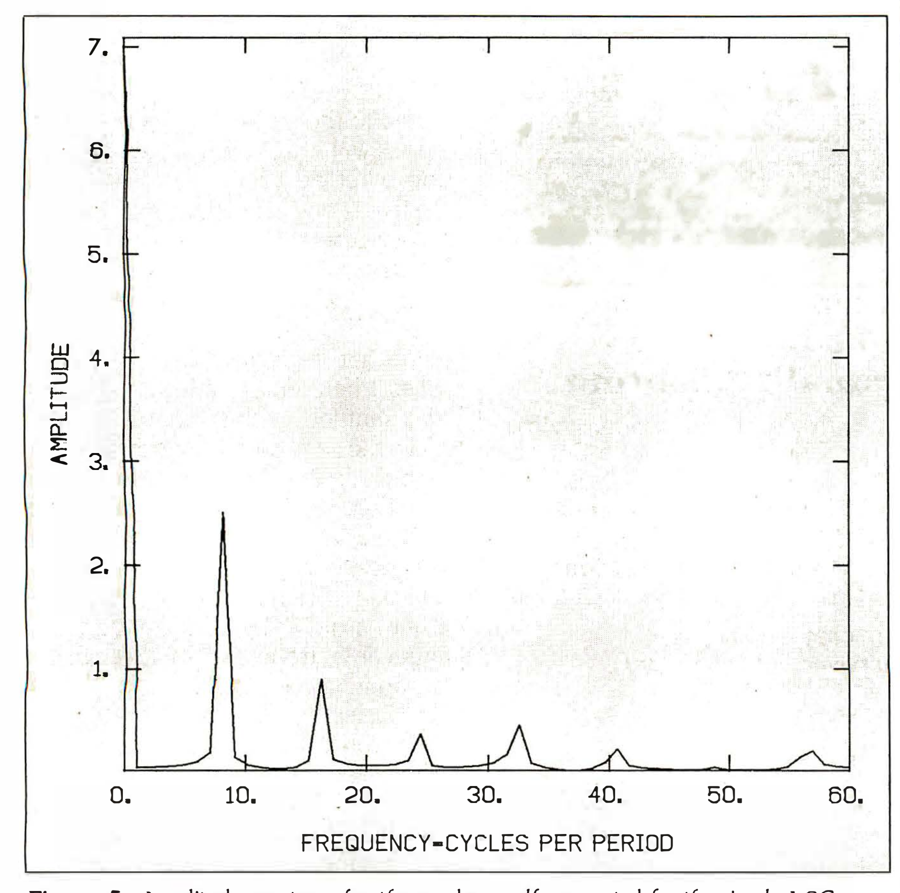


Figure 5: *Amplitude spectrum for the random walk generated by the simple LCG in figure 3. The sharply peaked pattern indicates a highly repetitive pattern.*

An LCG's period has two limitations: only integers less than the modulus are generated; and the series is deterministic.

early repetition of the pattern.

Another way to think of this manipulation is in terms of a fictitious game of solitaire. Suppose I have two decks of cards. One of them has been shuffled, but I am asked to produce the longest possible nonrepeating series by laying down the cards from the unshuffled deck. I must follow some well-defined rule of my own choosing, and when I have gone through the deck I can start again. Before continuing, however, I must put the cards back into their original order. Since I cannot shuffle the deck in the usual way, if I merely start over, I will have come to the end of the deck and the series will repeat. What can I do with the other deck?

Here is one procedure, and you can invent others that will work just as well or better. They are analogs for shuffling in the LCG. (The two decks correspond to the two LCGs.) Lay the cards in the unshuffled deck into five piles. Then remove a few cards from the shuffled deck so that it will not have the same number as the unshuffled deck. Then draw a card from the shuffled deck and take its value modulo 5 to compute a number designating one of the five piles. Select the first card from that pile and put it into a discard pile. Continue drawing cards from the shuffled deck, computing the number of their piles and selecting a card from that pile until you exhaust the shuffled deck. Then, start again with the cards in the same order. When the five piles from the unshuffled deck are exhausted, pick up the discard pile, put the cards back into their original order, and lay out five piles again. Continue as before. You will probably find that the

order is quite different the second time and in succeeding sequences. The success of this method depends on having an appropriate number of piles and taking an appropriate number of cards out of the shuffled deck before starting. In a similar way, the success of the shuffled LCG depends on the two series having appropriate relationships between them.

The efficiency of the shuffling technique is quite spectacular. For instance, from a pair of LCGs with periods of only 8 and 9, you can generate a pseudorandom series with a period greater than 200. By tailoring the pair of LCGs to the word length of the computer, you can create shuffled LCGs with much longer periods.

Listing 1 is a BASIC shuffling program that generates a random walk consisting of *NG* groups of *NS* steps and prints the displacement after each group. By analyzing this listing, you can develop a random-number subroutine suitable for virtually any computer. Notice that subroutine 1010 initializes the program by filling the "piles" with numbers, as in laying out the five piles of cards described above. The program uses two distinct LCGs, and their parameters are listed in statement 32. Before demonstrating the power of this program, I will describe how I selected these parameters.

TAILORING A SHUFFLED LCG

I looked for the largest modulus and the largest multiplier consistent with

(continued)

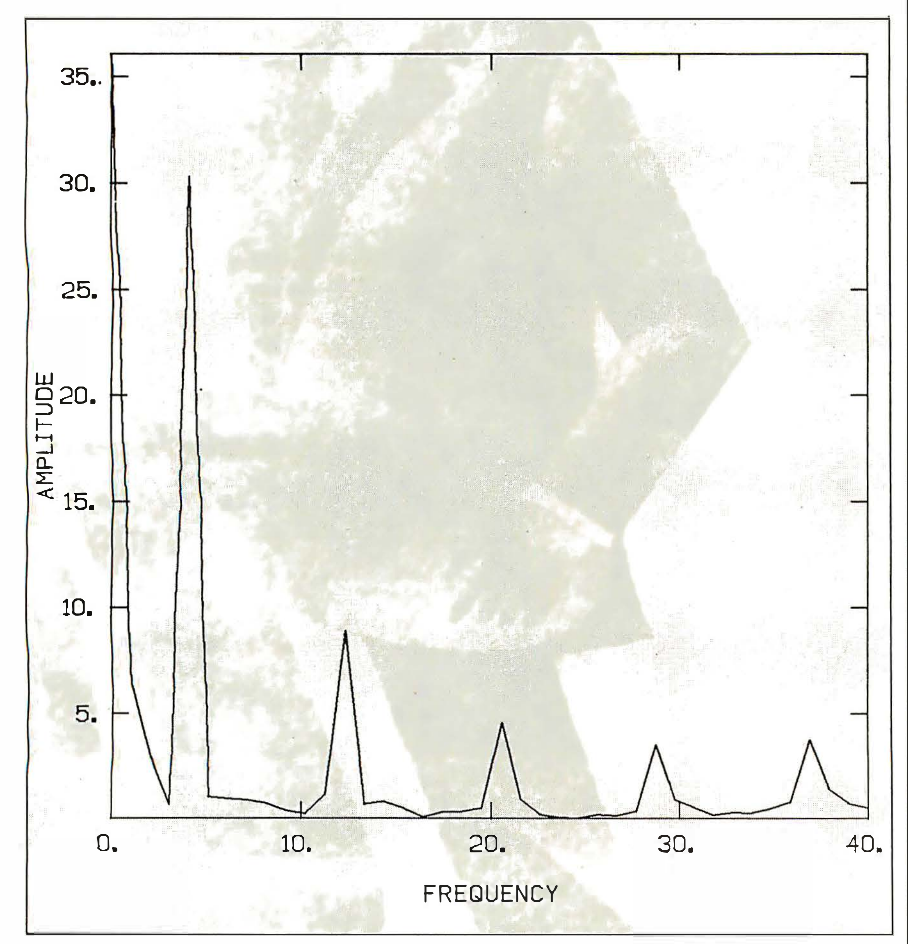


Figure 6: *Amplitude spectrum for the Advanced BASIC random-number generator, showing the prevalence of certain cycles. "Frequency" is the number of cycles in 64,000 steps. The peak at about 4 corresponds to the wavy pattern evident in figure 4.*

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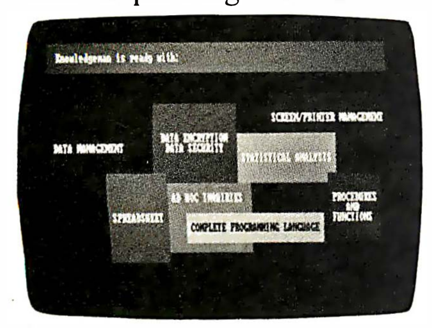
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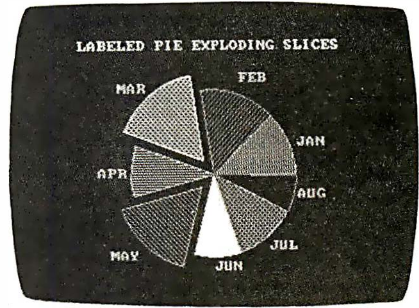
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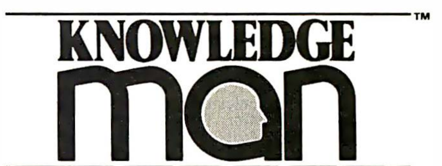
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I_{max} = 32,768, the largest integer my computer can handle.

I first needed an expression for the largest integer that will be computed by a particular LCG. It is approximately $a \times m + c$ before it is reduced modulo, m. This integer must satisfy $a \times m + c < I_{max}$.

The condition $a > \sqrt{m}$ also constrains the multiplier to avoid serial correlations. These two constraints suggest taking a small value for the additive constant, c, and setting $a = m$, which leads to the approximate relationship $a = m = \sqrt{(I_{max})}$. For a 16-bit computer, I_{max} = 32,768, which implies $a = m < 181$. Thus, you can construct a shuffled LCG from a pair of LCGs with periods less than 181. I then wrote a program to run through the output of an LCG and test for full period. After some experimenting, I found that the following pair of LCGs have full periods: $I_{i+1} = \mathrm{mod}(111 I_i + 11, 151)$; and $I_{i+1} = \mathrm{mod}(113 I_i + 13, 137)$. Finally, the choice of the number of piles did not seem to me to be critical, and I settled on NPILES = 121.

Figure 7 shows a 50,000-step random walk generated on an IBM PC by

(continued)

Listing 1: *A program in* BASIC *for generating pseudorandom sequence from two LCGs with shuffling.*

```
10    ' PROGRAM RANWALK5 with shuffling; MS-BASICA
15    OPEN "RANWALK5.OUT" FOR OUTPUT AS #2
16    DIM IXS(200)
18    INPUT "NPILES";NPILES ' *** Use NPILES = 121 for secondary list
30    INPUT "SEED";IS
32    IM2=137:IA2=113:IC2=13:IM1=151:IA1=111:IC1=11 ' *** LCGs
34    GOSUB 1010 ' TO INITIALIZE RAND
40    INPUT "STEPS PER GROUP";NS
50    INPUT "NUMBER OF GROUPS"; NG
60    PRINT -2, "RANWALK5,
      LCG#(111,11,151),LCGC(113,13,137):";NS;NG;NPILES
68    ICOUNT = 0
70    FOR I = 1 TO NG
90    FOR J = 1 TO NS
92    GOSUB 2010 ' TO COMPUTE RAND
93    ICOUNT=ICOUNT+1
94    IF ICOUNT=NPILES+1 THEN GOSUB 1010:ICOUNT=0 ' reset piles
100   IF RAND >.50 THEN MD=1 ELSE MD=-1
110   M = M + MD
111   NEXT J
114   PRINT #2,I;",";M;",' ' *** output of random displacement
128   NEXT I
130   GOTO 5000
140   ' *** end of main program
1000  ' *** Initialize piles of secondary list for shuffling
1010  FOR IK = 1 TO NPILES
1020  IX1=IX1*IA1+IC1
1022  JJ=INT(IX1/IM1):IX1=IX1-IM1*JJ
1029  IXS(IK)=IX1
1030  NEXT IK
1040  RETURN
2000  ' *** RAND drawing from piles without replacement
2010  IX2=IX2*IA2+IC2
2011  JJ=INT(IX2/IM2):IX2=IX2=IX2-JJ*IM2
2012  ICELL = INT(NPILES*IX2/IM2)+1
2020  RAND=IXS(ICELL)/IM1
2040  RETURN
5000  END
```

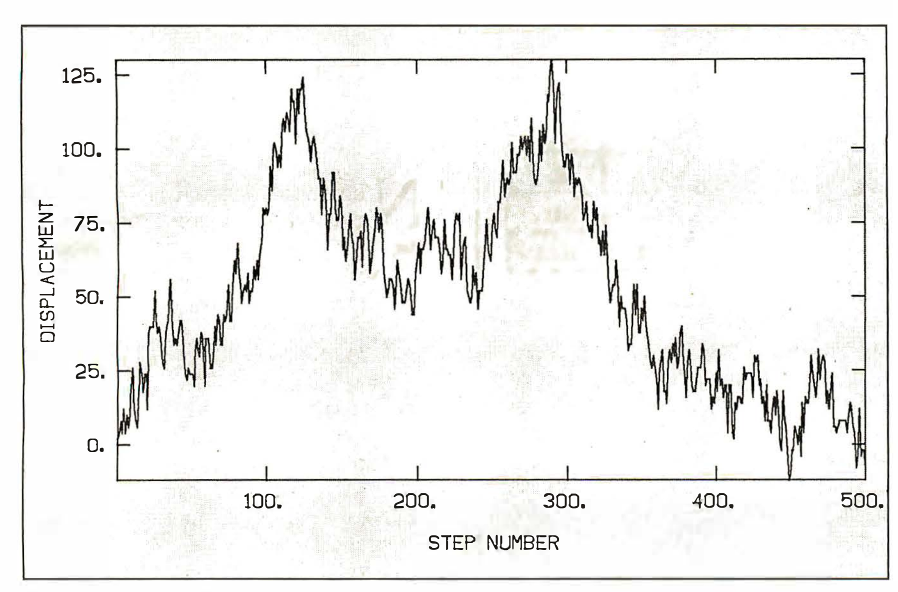


Figure 7: *A random walk with shuffling, tailored to a 16-bit computer. In the absence of shuffling, this generator would be limited to a period of several hundred. With shuffling, the period is longer than 50,000. This walk was generated with an IBM PC.*

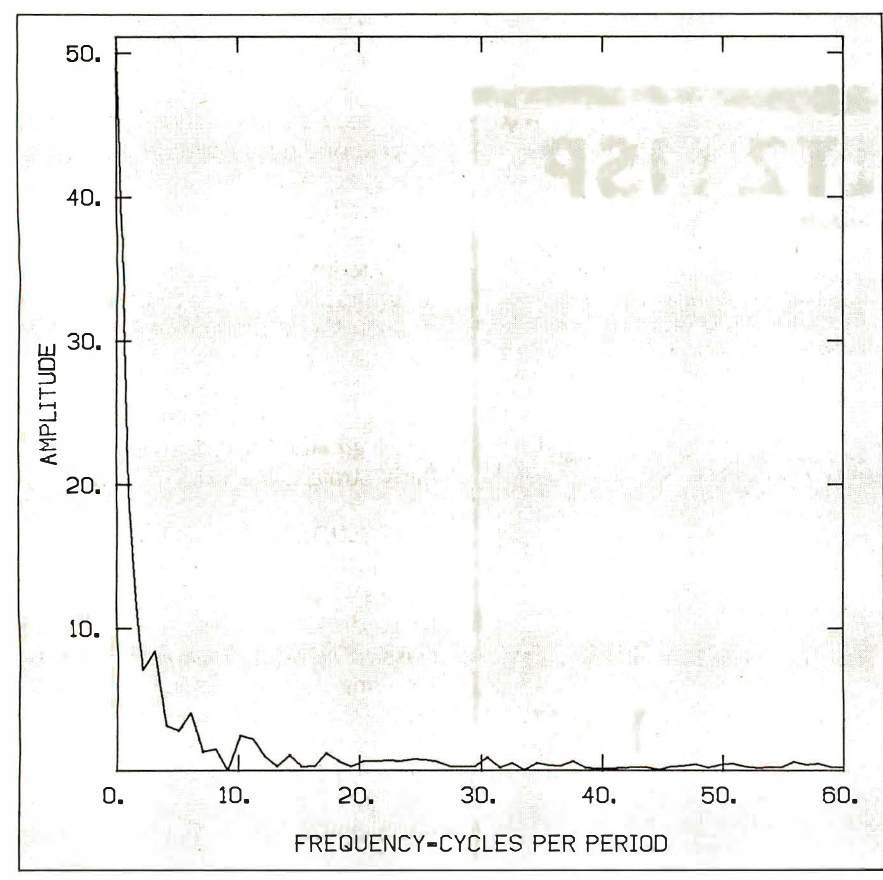


Figure 8: *Amplitude spectrum of the random walk in figure 7, showing absence of significant periodicities and indicating that the shuffled pair of LCGs passes this test successfully.*

Fourier Spectrum

Named for the French mathematician J. B. J. Fourier (1768–1830), the Fourier series is a representation of a series of data points, $F(t)$, as a sum of harmonic terms in the form

$$F(t) = \Sigma\ |a_n \sin(nwt) + b_n \cos(nwt)|$$

When $F(t)$ is specified at a discrete set of points—such as the displacements in a random walk at uniformly spaced times—the coefficients, a_n and b_n, can be found by summing products of the data and the trigonometric functions. These coefficients comprise the amplitude spectrum, and the quantity sqrt($a_n^2 + b_n^2$) is a measure of the importance of harmonic frequency nw in the data. Large values of a_n or b_n indicate that the data has a significant component of variation with a period $2\pi/(nw)$.

using listing 1, and figure 8 shows the corresponding amplitude spectrum. The spectrum shows a wide and fairly smooth distribution of frequencies, and the period of this shuffled LCG is evidently very long. A walk of this length represents a satisfactory type of pseudorandom-number generator for use with 16-bit computers. When 32-bit machines come along, changing the parameters to take advantage of the greater range of integers will be fairly straightforward.

Concluding Remarks

If you want to pursue the art of making new generators, I recommend Donald E. Knuth's three-volume classic, *The Art of Computer Programming* (Reading, MA: Addison-Wesley Publishing Co., Vol. 1 |2nd ed.|, 1974; Vol. 2 |2nd ed.|, 1981; Vol. 3, 1973).

I've tried to show that the testing of random-number generators is important but not difficult. In fact, developing your own tests is an interesting game. There is no single right way, but the listing for the program provided here works quite well on my 16-bit machine. ■

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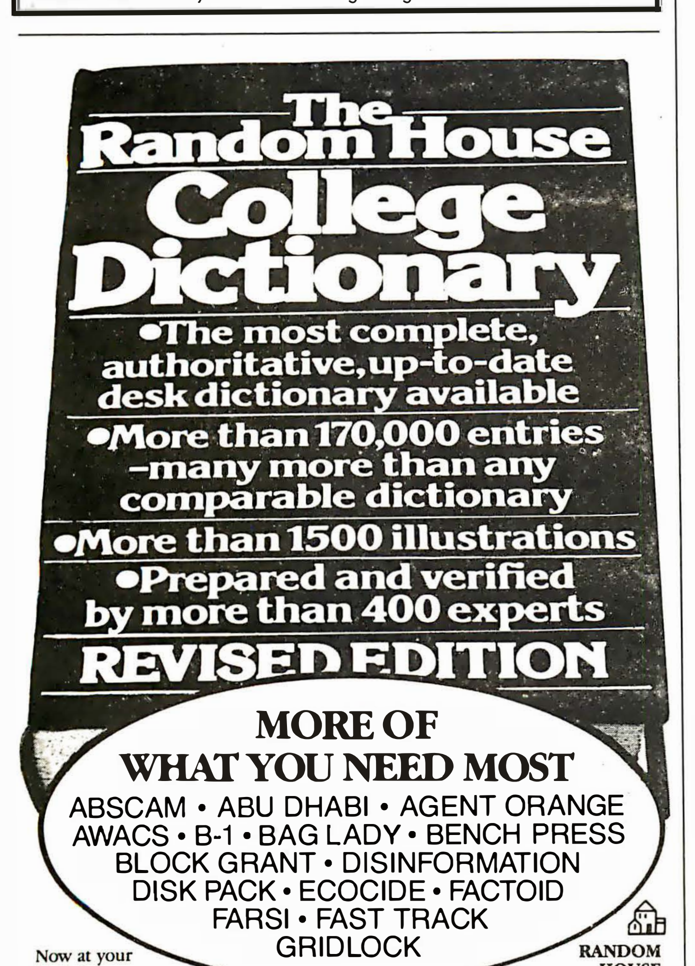
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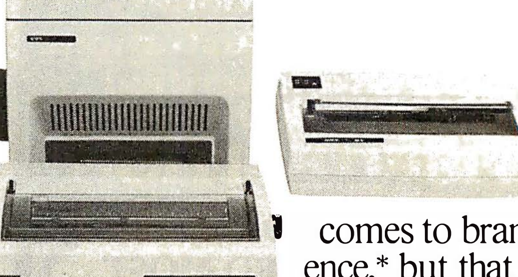
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ADAPTIVE FILTERING PREDICTION AND CONTROL, Graham C. Goodwin and Kwai Sang Sin. Englewood Cliffs, NJ: Prentice-Hall, 1984; 560 pages, 18.5 by 24 cm, hardcover, ISBN 0-13-004069-X, $41.95.

THE ADDISON-WESLEY BOOK OF ATARI SOFTWARE 1984, Jeffrey Stanton, Robert P. Wells, Sandra Rochowansky, and Michael Mellin. Reading, MA: Addison-Wesley, 1984; 432 pages, 21.3 by 27.8, softcover, ISBN 0-201-16465-X, $19.95.

ADVANCED MECHANISM DESIGN: ANALYSIS AND SYNTHESIS, Vol. 2, George N. Sandor and Arthur G. Erdman. Englewood Cliffs, NJ: Prentice-Hall, 1984; 704 pages, 16.3 by 24.3 cm, hardcover, ISBN 0-13-011437-5, $45.95.

THE ANATOMY OF THE COMMODORE, Michael Angerhausen, Achim Becker, Lothar Englisch, and Klaus Gerits. Grand Rapids, MI: Abacus Software, 1984; 298 pages, 13.8 by 20.8 cm, softcover, ISBN 0-916439-00-3, $19.95.

THE ANATOMY OF THE 1541, Lothar Englisch and Norbert Szczepanowski. Grand Rapids, MI: Abacus Software, 1984; 328 pages, 13.8 by 20.8 cm, softcover, ISBN 0-916439-01-1, $19.95.

APPLE II APPLICATIONS, Marvin L. De Jong. Indianapolis, IN: Howard W. Sams & Co., 1983; 240 pages, 13.5 by 21.3 cm, softcover, ISBN 0-672-22035-0, $13.95.

THE ART OF COMPUTER MANAGEMENT, Jim McNitt. New York: Simon & Schuster, 1984; 272 pages, 14.5 by 22 cm, hardcover, ISBN 0-671-46471-X, $15.95.

ARTIFICIAL INTELLIGENCE, Tim O'Shea and Marc Eisenstadt, eds. New York: Harper & Row, 1984; 500 pages, 18.5 by 23.5 cm, softcover, ISBN 0-06-041894-X, $25.50.

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BEYOND PROBLEM SOLVING AND COMPREHENSION, Arthur Whimbey and Jack Lochhead. Philadelphia, PA: The Franklin Institute Press, 1984; 400 pages, 15.3 by 22.8 cm, softcover, ISBN 0-89168-051-9, $14.95.

A BIT OF LOGO MAGIC, Donna Bearden. Reston, VA: Reston Publishing, 1984; 110 pages, 21.3 by 28 cm, softcover, ISBN 0-8359-0495-4, $10.95.

BUSINESS BASIC, 2nd ed., Robert J. Bent and George C. Sethares. Monterey, CA: Brooks/Cole Publishing, 1984; 304 pages, 21.8 by 27.8 cm, softcover, ISBN 0-534-03179-X, $20.95.

COMMODORE MAGIC, Michael Callery. New York: E. P. Dutton, 1984; 240 pages, 17.8 by 22.8 cm, softcover, ISBN 0-525-48120-6, $12.95.

COMPUTER BOOKS AND SERIALS IN PRINT 1984, R.R. Bowker Company's Department of Bibliography and Serials Bibliography Department with the Publication Systems Department. New York: R. R. Bowker, 1984; 580 pages, 22 by 28.5 cm, ISBN 0-8352-1814-7, $49.50.

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the editors of *Consumer Guide.* New York: Ballantine Books, 1984; 256 pages, 15.3 by 22.5 cm, softcover, ISBN 0-449-90127-0, $6.95.

COMPUTER COMPANION FOR THE APPLE II/APPLE IIe, Robert P. Haviland. Blue Ridge Summit, PA: Tab Books, 1983; 128 pages, 13 by 21 cm, spiral-bound, ISBN 0-8306-1603-9, $10.25.

COMPUTER COMPANION FOR THE SINCLAIR/TIMEX COMPUTERS, Robert P. Haviland. Blue Ridge Summit, PA: Tab Books, 1983; 128 pages, 13 by 21 cm, spiral-bound, ISBN 0-8306-1623-3, $10.25.

COMPUTER COMPANION FOR THE VIC-20, Robert P. Haviland. Blue Ridge Summit, PA: Tab Books, 1983; 128 pages, 13 by 21 cm, spiral-bound, ISBN 0-8306-0613-0, $10.25.

COMPUTER LITERACY SURVIVAL KIT, Arthur Luehrmann and Herbert Peckham. New York: McGraw-Hill, 1984; 430 pages, 18.5 by 23.3 cm, softcover, ISBN 0-07-049206-9, $29.95. Includes floppy disk.

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ELECTRONIC ILLUSIONS, Ian Reinecke. New York: Penguin Books, 1984; 256 pages, 12.8 by 19.8 cm, softcover, ISBN 0-14-00-7103-2, $7.95.

FREE SOFTWARE FOR THE IBM PC, Bertram Gader and Manuel V. Nodar. New York: Warner Books, 1984; 480 pages, 13.3 by 20 cm, softcover, ISBN 0-446-38143-8, $39.95.

GRAPHICS GUIDE TO THE COMMODORE 64, Charles Platt. Berkeley, CA: Sybex, 1984; 288 pages, 17.8 by 22.8 cm, softcover, ISBN 0-89588-138-1, $15.95.

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HOW TO PROGRAM YOUR COMMODORE 64, Tim Hartnell. New York: Ballantine Books, 1983; 128 pages, 15.3 by 22.8 cm, softcover, ISBN 0-345-31663-0, $6.95.

HOW TO PROGRAM YOUR IBM PC, Tim Hartnell. New York: Ballantine Books, 1983; 112 pages, 15.3 by 22.8 cm, softcover, ISBN 0-345-31661-4, $6.95.

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INTRODUCTION TO COMPUTER SCIENCE USING THE TURING PROGRAMMING LANGUAGE, R. C. Holt

(continued)

a message to our subscribers

From time to time we make the BYTE subscriber list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

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BOOKS RECEIVED

and J. N. P. Hume. Reston, VA: Reston Publishing, 1984; 416 pages, 18 by 24 cm, hardcover, ISBN 0-8359-3168-4, $24.95.

AN INTRODUCTION TO PROGRAMMING THE ACORN ELECTRON, R. A. and J. W. Penfold. London, England: Bernard Babani Ltd., 1984; 144 pages, 11 by 17.8 cm, softcover, ISBN 0-85934-117-8, £1.95.

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LEARNING TRS-80 MODEL 4/4P BASIC, David A. Lien. San Diego, CA: Compusoft Publishing, 1984; 500 pages, 17.5 by 22.8 cm, softcover, ISBN 0-932760-19-8, $19.95.

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A MULTIPROCESSOR OPERATING SYSTEM, Mathai Joseph, V. R. Prasad, and N. Natarajan. Englewood Cliffs, NJ: Prentice-Hall, 1984; 496 pages, 15.8 by 23.5 cm, hardcover, ISBN 0-13-605170-7, $28.95.

THE 99000 MICROPROCESSOR, Avtar Singh and Walter A. Triebel. Englewood Cliffs, NJ: Prentice-Hall, 1984; 208 pages, 18.3 by 24.3 cm, hardcover, ISBN 0-13-622853-4, $23.95.

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THE POWER OF: FINANCIAL CALCULATIONS FOR LOTUS 1-2-3, Robert E. Williams. Englewood Cliffs, NJ: Prentice-Hall, 1984; 180 pages, 21.3 by 27.5 cm, softcover, ISBN 0-13-687690-0, $28.95.

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THE PROGRAMMING GUIDE TO THE Z80 CHIP, Phillip R. Robinson. Blue Ridge Summit, PA: Tab Books, 1984; 360 pages, 13 by 21 cm, softcover, ISBN 0-8306-1656-X, $13.50.

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PROGRAMMING WITH STRUCTURED FLOWCHARTS, Krishna K. Agarwal. Princeton, NJ: Petrocelli Books, 1984; 184 pages, 13.8 by 20.8 cm, softcover, ISBN 0-89433-226-0, $12.

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THE SALARIED PROFESSIONAL, Joseph A. Raelin. New York: Praeger Publishers, 1984; 304 pages, 16 by 24 cm, hardcover, ISBN 0-03-068918-X, $35.95.

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SWIFT'S DIRECTORY OF EDUCATIONAL SOFTWARE FOR THE IBM PC, 1983-84 edition. Austin, TX: Sterling Swift Publishing Co., 1984; 234 pages, 14 by 21.5 cm, three-hole punched, ISBN 0-88408-274-1, $18.95.

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NEW SYSTEMS

PC-Compatible ES.3 Comes with Telephone



The ES.3 professional workstation from Zaisan combines compatibility with the IBM Personal Computer and a built-in telephone for concurrent voice/data communications. Simultaneous voice and data communications can be achieved using two telephone lines. The use of the telephone or any productivity software does not suspend an operational program.

The telephone control console has a Touch-Tone keyboard, 13 programmable telephone function keys, and 8 dynamic soft keys for menu selection. A telephone directory with single-keystroke dialing and automatic redialing of the last 15 numbers called are provided. A calendar-management function helps you keep track of appointments and jot down notes. Additional features include a handset, a speakerphone, and a pair of modular (RJ-11) phone jacks.

The ES.3's computer hardware is made up of a 9-inch high-resolution nonglare screen, an internal full-duplex 300-bps modem, a detached keyboard with 10 function keys, a 360K-byte floppy-disk drive, and an integrated package of software. Three processors, the Z80, a CMOS 6805, and an 8088, control operations and are backed by 128K bytes of RAM. A real-time clock and a parallel printer port are also supplied.

The monitor has a 25-row by 80-character format and produces 7- by 9-dot green characters on a black background. A PC color card-compatible graphics display with eight monochrome shades is standard.

The ES.3 runs under MS-DOS. System software comprises a telephone directory, calendar reminder, phone log, scratch-pad storage, and electronic message/text editor.

Up to 640K bytes of RAM are optional. Some of the other options are an RS-232C serial and cassette interface, a second communications channel, a disk drive, and battery-backed RAM and ROM cartridges. The ES.3's suggested retail price is $2595. For further details, contact Zaisan Inc., 14511 Falling Creek, Houston, TX 77014, (713) 580-6191.

Circle **609** on inquiry card.

UNIX Environment for Multiusers Has Low Per-User Cost

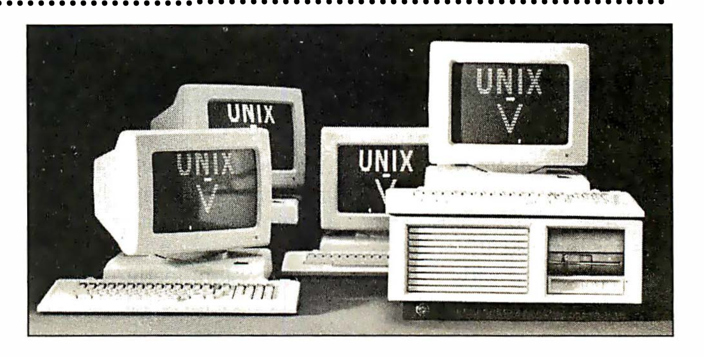
Morrow's Tricep, a 16-/32-bit microcomputer, supports four to eight users under UNIX System V. Retail pricing begins at less than $9000, and the manufacturer claims that a UNIX environment can be operated with a per-user cost of under $2500.

The 10-MHz MC68000 serves as the Tricep's central processing unit. Optional 80188 slave boards running MS-DOS are used to free the central processor of applications overhead and to create a local operating arena with a dedicated processor and 128K bytes of dual-ported RAM, expandable to 512K bytes. The 68000 loads tasks into the slave's memory for execution.

Tricep comes with an onboard MC68451 memory-management unit, 512K bytes of RAM, an I/O controller with four RS-232C serial ports, a Centronics-type parallel printer port, and DMA controllers for both floppy- and hard-disk drives. System boards plug into the Tricep's 14-slot S-100 backplane.

Mass storage is provided by one to four 16- or 32-megabyte 5¼-inch Winchester hard-disk drives. The maximum hard-disk storage capacity is 128 megabytes. Optional storage schemes can be ordered.

The serial I/O controller communicates with terminals and printers at rates as high as 19,200 bps. The hard-disk controller averages 85 milliseconds per seek with the 16-megabyte Winchester and



35 milliseconds with the larger unit. The data-transfer rates are up to 625K bytes per second.

Tricep runs a version of Unisoft Systems' UNIX that is fully compatible with the AT&T Bell Laboratories standard and has been enhanced with record-locking and floating-point capabilities. An optimizing C language compiler is supplied. Available languages are Ada, BASIC, COBOL, FORTRAN-77, and Pascal.

Ethernet local-area network support and graphics will be available. The slave boards cost less than $700. For more information, contact Morrow Inc., 600 McCormick St., San Leandro, CA 94577, (415) 430-1970.

Circle **610** on inquiry card.

(continued)

NEW SYSTEMS

Vantage Point Manages Energy, Runs CP/M At Same Time

The Vantage Point Computer is a multiprocessor computer that can simultaneously perform energy-management and security functions and run standard CP/M applications software.

The primary unit contains multiple Z80As, a pair of 1-megabyte (unformatted) floppy-disk drives, 128K bytes of RAM, 16-channel A/D and 16-channel D/A converters, a real-time clock, three RS-232C serial interfaces, a Centronics port, and a 12-slot motherboard. A built-in scientific calculation function lets you tabulate figures and insert them into a program on screen.

The detachable keyboard has 93 keys, including 20 function keys. All control, monitoring, and applications programming are handled through the Vantage Point's keyboard. The green-screen monitor has an 80-column by 24-line format and a status line.

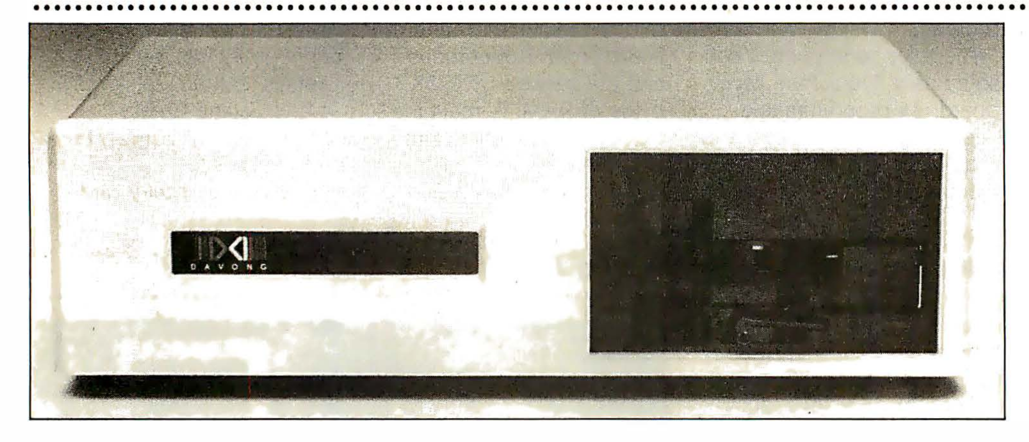
A plug-in firmware card gives the Vantage Point the ability to perform real-time office security and energy management and has been nicknamed ROSE. The ROSE card allows standard CP/M applications to run on screen, while the system monitors the office and manages energy usage in the background. The status line displays the time, date, day of week, and zone security and energy conditions. A multitasking technique lets ROSE handle more than 100 interface points in real time.

More than 15 functions cards are available for customization. RAM can be extended to 1 megabyte. The basic Vantage Point Computer costs $6500 with ROSE. For more information, contact Industrial Computer Designs Inc., 31121 Via Colinas #1005, Westlake Village, CA 91362, (818) 889-3179.

Circle **611** on inquiry card.

MASS STORAGE

Hard Disk with Tape Backup Designed for PC



DataSystem from Davong is a hard-disk and tape backup combination for the IBM PC and PC XT. It is offered with 10-, 21-, 32-, or 40-megabyte capacities, each with a built-in 24-megabyte tape backup system with an on-line performance option.

DataSystem features compressed or full-volume backup, file-by-file or full-volume restore, and automatic flaw mapping for complete media interchangeability. Password protection is available with the use of Davong's Multi-OS software.

The hard disk uses two to eight heads and a corresponding number of cylinders, depending on capacities. The average access times are 40 to 100 milliseconds, and the disk-transfer rate is 62.5K bytes per second. The interface to the IBM requires one short slot. User-selectable features include two interrupts, a pair of DMA channels, and 16 bytes of I/O memory.

Prices range from $3295 to $4995. For further details, contact Davong Systems Inc., 217 Humboldt Court, Sunnyvale, CA 94089, (408) 734-4900.

Circle **612** on inquiry card.

Streaming Tapes for Winchesters Boost IBM's Storage

Dragon Industries recently introduced 45- and 60-megabyte streaming-tape backup system options for its IBM-compatible SP-65 and SP-140 hard-disk drives. The streaming tapes have a single-track serpentine and nine recording tracks for data transfer and read-after-write recording mode.

The read/write transfer rate of the streamer tape averages 86.7K bytes per second (200K bytes per second maximum). Both the read/write speed and the rewind rate are 90 ips.

The SP-65 and the SP-140 are 5¼-inch Winchester hard-disk drives offering formatted storage capacities of 57 and 121 megabytes, respectively. Both are supplied with controller, host adapter, power supply, cables, and PC-/MS-DOS compatibility. The SP-65 is $4995, and the SP-140 sells for $6995.

The streaming tapes are offered in a dual box with the Winchesters and as upgrades. The SP-65 with its streaming-tape backup is $6995, while the SP-140 with its backup is $2000 more. The upgrades are $2195. Contact Dragon Industries, 35 Main St., Hopkinton, MA 01748, (800) 824-8006; in Massachusetts, (617) 435-4183.

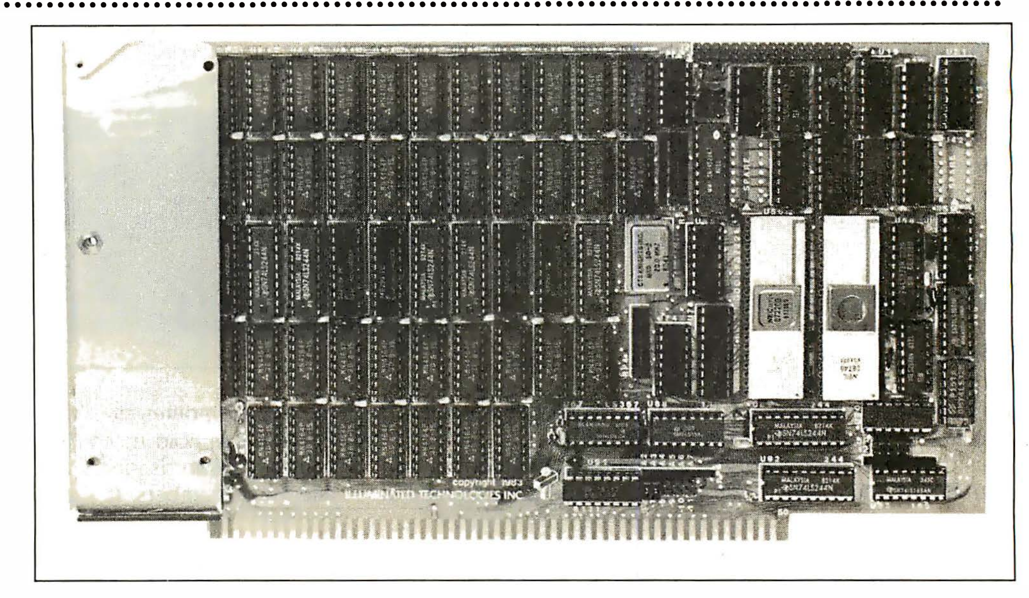
Circle **613** on inquiry card.

ADD-INS

Color Graphics Board for S-100

Illuminated Technologies GB3MP is a single-board S-100 color graphics controller with 348K bytes of RAM under the direction of the 16-bit NEC 7220 graphics processor. This board can produce an eight-color display of 1024 by 1024 pixels. Pixel rates of up to 44 MHz are supported. Connections to a host are through a block of four S-100 I/O ports.

Supplied utilities program the GB3MP for use with any RGB or monochrome monitor. Monitors can be configured for 640- by 480-pixel resolution. High-performance monitors can display a raster of 1200 by 872 pixels.



The NEC 7220 chip carries out arc and vector drawing in microcode to provide a drawing speed of 1.65 million pixels per second. Complete driver software and interactive drawing utilities are supplied in C and as executable programs.

An 8748 processor for character-display functions is optional. The GB3MP is $1195 for eight colors or $895 for the upgradable monochrome version. Contact Illuminated Technologies Inc., POB 83348, Oklahoma City, OK 73148, (405) 943-8086.

Circle 614 on inquiry card.

Multibus Computer Built Around 16032

The ZP1632 is a single-board Multibus computer based on the 32-bit 16032 microprocessor from National Semiconductor, which has full internal 32-bit data paths and a 16-bit external architecture.

The board includes a 16082 memory-management unit, which implements a demand-paged virtual memory-management architecture that is similar to the VAX-11's. The MMU automatically detects page faults and protection violations and invokes the abort and retry features of the 16032. The ZP1632 also is equipped with a 16081 floating-point unit, providing it with 32- and 64-bit IEEE-compatible floating-point instructions.

The ZP1632 features 16 prioritized vector interrupts, 16-megabyte (24-bit) direct addressing, 256K bytes of on-board parity-checked dynamic RAM, 16K bytes of on-board ROM, two asynchronous ports, and one parallel I/O port. RAM is expandable to 1 megabyte, and ROM can be expanded to 128K bytes. The serial and parallel I/O is provided through a Signetics SCN 2681 dual UART and an Intel P8255A parallel interface. An iLBX memory port provides a direct-access memory bus for high-speed data transfers.

An optional monitor program that's compatible with National Semiconductor's NSX16 cross-development software is available. The ZP1632 costs $2350, when fully configured. In Canada, the price is $2995. Contact TIL Systems Ltd., Suite 1100, 60 Yonge St., Toronto, Ontario M5E 1H5, Canada, (416) 869-1157.

Circle 615 on inquiry card.

Overlay Computer Graphics with Video

The PC-MicroKey System from Video Associates Labs lets you overlay computer-generated text and graphics on any incoming video source. This plug-in board, which is available in different packages, works with any IBM PC software.

The PC-MicroKey System Level I is an RGB-only system that works with videodisc players equipped with external sync. It's suitable for interactive training stations and point-of-sale displays. A Sony KX series monitor or its equivalent is required.

The second package, Level II, adds broadcast-quality NTSC composite-video output to the RGB capability of the Level I system. Level II can overlay graphics with the output of any videodisc player, videotape player, still-frame videotape, or camera.

Both boards operate in conjunction with the IBM, Plantronics, or Tecmar graphics cards. Level I costs $900, and Level II is priced at $1805. For more information, contact Video Associates Labs Inc., Suite B-106, 3933 Steck Ave., Austin, TX 78759, (512) 346-5781.

Circle 616 on inquiry card.

(continued)

PERIPHERALS

Dial-back Authenticator Guards Data

Sleuth, a dial-back access authenticator, connects your modem and the Hayes Smartmodem and prevents unauthorized use of data ports.

Sleuth requires all would-be users to enter a password and to identify themselves. After receiving the password and identification, it disconnects the dialer and proceeds to verify the caller's authenticity. If the information matches its memory, Sleuth dials back the caller through the Smartmodem, which then establishes normal connections.



Sleuth is menu-driven and can only be programmed at the host computer site. Its EAROM can hold up to 74 names, passwords, and telephone numbers. It supports such long-distance networks as MCI and Sprint, and its operation is totally transparent to normal outgoing calls.

Compatible with computers using standard RS-232C interfaces, Sleuth does not require external software. The suggested retail price is $465, which includes power supply, manual, and an RS-232C cable. Contact C. H. Systems Inc., Suite 106, 8533 West Sunset Blvd., Los Angeles, CA 90069, (213) 854-3536.

Circle 617 on inquiry card.

Integrated Systems Automate Data Acquisition and Control

Cyborg Corporation's ISAAC 41-I and ISAAC 91-I are integrated systems for automated data acquisition and control. They work with the IBM Personal Computer and are designed to automate analytical instruments and industrial processes. These units are suitable for temperature monitoring, measuring vibrations, and observing physiological testing.

ISAAC 91-I is a general-purpose system designed for workstation applications. Its hardware includes an IBM interface, 16 channels of 12-bit A/D converters, 4 channels of D/A converters, 16 binary inputs and outputs, 4 programmable Schmitt triggers, a 16-bit timer, and 8 slots for the Cyborg I series expansion boards.

Cyborg's ISAAC 41-I is a modular system for applications that do not require the capabilities of the ISAAC 91-I. This device is made up of the interface, a system unit, and four expansion slots for D/A, A/D, and other functions. It's capable of handling up to 256 low-level inputs.

Both units have LabSoft software, which provides such programming tools as real-time signal acquisition routines, graphics utilities, and diagnostics. Its data-acquisition features can be combined with the analysis abilities of such programs as Lotus 1-2-3. In addition, both units can be programmed in interpreted or compiled BASIC, FORTRAN, or C.

A library of application notes and a variety of binary, signal-conditioning, remote, and multiplexing boards are optional. An extensive tutorial accompanies each unit. The ISAAC 41-I is $1900, and the ISAAC 91-I is priced at $4400. Contact Cyborg Corp., 55 Chapel St., Newton, MA 02158, (617) 964-9020.

Circle 618 on inquiry card.

EZ Adaptors Eliminate RS-232 Cable Mismatch

The EZ-232 Adaptor from Micro-Module Systems is a cabling system for interconnecting computers, peripherals, printers, terminals, modems, and any other serial equipment regardless of the type of connector used. A partial list of manufacturers whose connectors are supported by EZ-232 includes Alpha Micro, Apple, Anderson-Jacobson, Centronics, Columbia, Epson, Hewlett-Packard, IBM, Okidata, Quadram, Radio Shack, Tektronix, US Robotics, and Zenith.



The EZ-232 Adaptors terminate in standard six-wire, RJ-12 jacks and are attached to the computer's serial port and to the peripheral device's port. Telephone cabling is then plugged into each Adaptor, completing the interface.

The EZ-232 Adaptors cost $12.95 each. The cabling costs between $8 and $10, depending on length. Contact Micro-Module Systems Inc., POB 2198, La Jolla, CA 92038, (619) 268-8028.

Circle 619 on inquiry card.

SOFTWARE • APPLE

Communications Channels Between IBM and Mac Established

PC to Mac and Back bridges the communications gap between the IBM PC and the Apple Macintosh. This program will transfer files between an IBM PC and a Mac, two Macintoshes, two IBM PCs, or between the Mac or IBM to any other computer with an RS-232C serial port and communications software. In addition, a Mac or PC equipped with this program can serve as a terminal to an information service, bulletin board, or a mainframe computer.

PC to Mac and Back has four modes of operation: text with handshake, PC to Mac and Back, X-Modem, and ASCII. The first mode provides error detection and ensures that transmitted files are saved by transferring data at appropriate intervals. The second mode provides error detection and automatic saving of transferred files and uses the capabilities of DOS 2.0, including the option of sending files with the filename and wildcard files. X-Modem provides error detection, and ASCII is a simple text mode without error detection.

This program makes use of pull-down menus on both the Mac and the IBM. It's compatible with the Microsoft mouse for the IBM; however, if you do not have a mouse, menu selection is done with cursor control with prompt lines.

The retail price for PC to Mac and Back has been set at less than $100. Contact dilithium Press Ltd., Suite 151 Southwest Nimbus, Beaverton, OR 97005, (800) 547-1842; in Oregon, (503) 646-2713.

Circle 620 on inquiry card.

Fast Graphics on Apple

Charts Unlimited combines machine-language speed and a 16-screen drawing area to give you fast graphics. It can create almost any type of chart including flowcharts, organizational charts, floor plans, Gantt charts, and block, wire, and circuit diagrams. It produces a worksheet grid of 124 columns by 90 rows for an effective work area of 868 by 630 pixels.

Charts Unlimited comes with 36 predefined shapes, such as triangles and brackets. You can modify the shapes and create and store alternative shapes. A 36-member set of symbols and the ability to draw solid or dashed lines in eight directions are standard.

Text can be intermingled with graphics anywhere on the worksheet. Hard-copy printouts measuring 8½ by 11 inches or 11 by 14 inches can be obtained from more than 25 different printers.

Charts Unlimited requires an Apple II with 64K bytes of memory. It costs $195. Contact Graphware Inc., 5084 Mosiman Rd., Middletown, OH 45042, (513) 424-6733.

Circle 621 on inquiry card.

Develop Mac Applications in FORTRAN or Pascal

Development software packages for the Macintosh are available from Softech Microsystems. The packages are compiled FORTRAN-77 and Pascal languages and a development toolkit with a 68000 assembler.

The UCSD Pascal development system allows access to the Mac's mouse, graphics, and text fonts, which are provided by the Mac's ROM. This arrangement lets you create applications that take full advantage of the Mac's user interfaces. In addition, UCSD Pascal and Apple Pascal are said to be compatible enough to permit porting of Apple II and III programs to the Mac. The suggested retail price is $195.

The FORTRAN-77 development system gives you an ANSI-77 subset of FORTRAN, complete with support for structured programming and improved character types. It lists for $295.

Softech's Advanced Development Toolkit bolsters the environment provided by the Pascal and FORTRAN-77 systems. It includes source code for a graphics/mouse interface, a symbolic debugger, a 68000 assembler, and a linker. With the Toolkit, you can analyze and optimize programs during development. It can be purchased for $150.

For further information, contact Softech Microsystems Inc., 16885 West Bernardo Dr., San Diego, CA 92127, (619) 451-1230.

Circle 622 on inquiry card.

Tutorial Programming Language

Spellcaster from Shenandoah Software is a computer language designed primarily to teach computer programming. It's made up of 32 primitive operations, most of which are graphic rather than numeric operations. A majority of the operations are entered through single keystrokes. Command response is instantaneous so that novice programmers can see the effect of each operation on their programs immediately.

Spellcaster uses such control structures as iteration, loop exits, IF . . . THEN . . . ELSE, subroutines, and recursion; it has no GOTOs. It also provides simple support for multiprocessing.

It shows beginners how to program art graphics and video games. The games, used as example programs, are featured because they have many requirements in common with modern DOSes, such as real-time control of multiple processes. More than 80 pages of on-screen tutorial are built into this program.

Spellcaster comes with a language interpreter, tutorial on disk, a manual, and a magazine called *The Spellswapper*, which is accompanied by a disk of Spellcaster programs and an extended tutorial. The suggested list price is $39.95. Versions are available for the Apple II series and the Commodore 64. It will be available for the IBM PCjr shortly. Contact Shenandoah Software, 1111 Mount Clinton Rd., Harrisonburg, VA 22801, (703) 433-8788.

Circle 623 on inquiry card.

(continued)

SOFTWARE • CP/M/MS-DOS

C Compiler and Statement Counter

Catalytix Corporation's Safe C Compiler provides extensive run-time checking of C-language programs and produces a dynamic trace of function calls with their arguments and returned values. It does not impose any restrictions on the use of C, and it accepts the same code as an ordinary C compiler. It checks for stray pointers and array indexes out of bounds and verifies that the types and number of arguments used agree between the function call and the function definition. Safe C Compiler flags arithmetic overflow, division by zero, and overflow in the standard routines for manipulating strings. It can be linked with object modules generated by other compilers.

Also from Catalytix is the Safe C Profiler, which provides statement-level statistics. It counts the number of times each function in a program is called and reports on the execution count for each statement during a run. It can indicate the number of times a particular loop is executed or how many times each branch of a conditional is taken. You can apply Profiler selectively to individual modules or particular functions. An auxiliary command displays the function profile as a table with a histogram or the statement profile alongside the original code. It's invoked as an option to the Safe C Compiler.

The Safe C Compiler for MS-DOS systems is $400. Profiler is $200. Contact Catalytix Corp., 55 Wheeler St., Cambridge, MA 02138, (617) 497-2160.

Circle 624 on inquiry card.

Program Creates Surveys

A survey-processing program, Synthesis comes with step-by-step instructions that show you how to build questionnaires, compile and analyze responses, and generate custom reports.

It can devise up to 120 questions per questionnaire, categorize up to 2500 respondents, check the correlation between questions, report the total number of responses for each question, and calculate up to 20 indexes as either averages or sums. It can select from three answer types and create seven response headings for each question. Questionnaires can have 24 group titles or footnotes. Synthesis tabulates the response distribution in absolute terms and percentages and computes the mean score for each question.

Synthesis runs on any MS-DOS-based computer with 128K bytes of RAM and two disk drives. It costs $595. A version that runs under AppleDOS 3.3 is available. Contact Bauer & Associates Inc., 210 East Huron St., Ann Arbor, MI 48104, (313) 668-1303.

Circle 625 on inquiry card.

Straight-through Printing Capability

Typewriter, a CP/M-80 program, lets you enter text directly from a keyboard to a printer. It gives you control over the print head's left, right, up, and down movements and four modes of operation: default, graphics, typewriter, and one-line word processing.

Spacing, direction, and font control is provided by the default mode. Its graphics mode lets you move and print out dots in any fashion, effectively converting a printer into a manual plotter. The typewriter mode is the straight-through typing ability. The last mode lets you enter, edit, and output a single line. Boldface and underlining are supported, but disk saves and multiline editing are not.

Versions of Typewriter are available for dot-matrix and daisy-wheel printers for $25. A combined package is $40. Contact MicroCost Software, 19705 1st Ave. S, Seattle, WA 98148.

Circle 626 on inquiry card.

Shared File Access Under dBASE

Communications Professionals' dLOCK permits multiuser, shared file access under dBASE II. It coordinates access to data files by making standard BDOS calls to the operating system to attempt to secure or lock a file for a user prior to allowing access. It returns to the dBASE command file with a return code that indicates success or failure of the lock attempt. dLOCK also provides a method of polling your keyboard to test for the presence or absence of a keystroke.

A hexadecimal file that loads into the free memory outside of dBASE, dLOCK is accessed through a standard CALL command. It works with most CP/M-80 compatible operating systems. It's $150 per user license. The manual alone is $15. For more information, contact Communications Professionals, Suite 1-238, 701 East Bay St., Charleston, SC 29403, (803) 722-7572.

Circle 627 on inquiry card.

Program Analyzes DC Networks

DCNAP is a general-purpose DC network analysis program from BV Engineering. This program can analyze circuits consisting of resistors, voltage sources, independent current sources, and dependent current sources. A circuit can contain as many as 200 components and 30 nodes. DCNAP automatically computes worst-case node voltages, component sensitivities, branch currents, and component power dissipation.

A built-in editor will add, delete, and change components and nodes. DCNAP accepts free-format input and has error-trapping capabilities. Its menu-driven input makes it easy to learn.

Versions of DCNAP are available for systems running under MS-DOS, CP/M, and PC-DOS. The list price is $62.95. Contact BV Engineering, Suite 207, 2200 Business Way, Riverside, CA 92501, (714) 781-0252.

Circle 628 on inquiry card.

SOFTWARE • IBM PC

Multidimensional Tables Manager Aids Decisions

Tables Manager/1, or TM/1, is a decision-management tool that gives managers a panoramic overview of the operating and financial picture of an organization. It helps analyze and control complex operating and financial statistics through its ability to create a tabular database that represents the many facets of an organization, such as payroll and research.

The database serves as the common denominator between dimensions; data is centralized rather than moved among tools. This approach minimizes input errors, simplifies cell dependencies, and eliminates spreadsheet maintenance. The TM/1 database can handle 9999 elements per dimension with up to eight dimensions per table. Twenty tables can be accessed simultaneously. The maximum file size is 8 megabytes.

The spreadsheet portion of TM/1 gives you 9999 lines and 9999 columns as well as a full set of editing commands. Other features include keyboard macros, integrated graphics, natural-order calculations, logical operators, data sorting on up to four fields, and string, math, financial, and time functions.

An IBM PC or Compaq with 192K bytes of RAM, MS-DOS 2.0, and a floppy- or hard-disk drive are required. The suggested price is $795. Contact Sinper Corp., 120 Northeast 9th St., Miami, FL 33132, (305) 371-8000.

Circle 629 on inquiry card.

Word Processor Aids Motor Disabled

H-Key is a word processor for individuals with severe motor disability. It's operated using a single switch, generally the space bar, and a keyboard displayed on screen. H-Key features word-wrap, full cursor control, insert, automatic underline, character and block delete, block move and copy, and page-breaking and get-page functions. It costs $25. Contact W. S. A., 40 89th St. #3C, Brooklyn, NY 11209.

Circle 630 on inquiry card.

Monitor Your Diet and Exercise

Master Control: A Diet and Exercise Program that runs on 128K-byte IBM computers strives to provide a comprehensive approach to weight management. It comes with *The Master Control Diet Guidebook*, which offers instructions on how to design a practical and effective diet and exercise program. The program calculates a diet using your information, monitors your progress, and provides graphic reports. Its database contains information on the caloric expenditure of more than 100 exercises and caloric count on more than 3000 foods. A quiz tests your understanding of information presented.

Two disk drives and a monochrome display or an 80-column color monitor are required. The price is $69.95, plus $3 shipping. A demonstration program costs $6 (credited toward purchase). Contact HealthWare, Suite 209, Physicians Plaza, 2300 Round Rock Ave., Round Rock, TX 78664, (512) 863-6910.

Circle 631 on inquiry card.

Wire-Wrapping Editor

When used in conjunction with an editor such as WordStar, Wirelist lets you manage all aspects of the wire-wrapping process. The editor handles the information needed to site components on a printed-circuit board, the types of component, and the logical connections between components. With this information, Wirelist produces a graphics display of each wire, which can then be connected, added, deleted, or rerouted. Wirelist can create forms and reports including wiring lists, debugging aids, and diagnostic reports. A board update facility generates a report outlining wires to be added or removed.

Wirelist can handle 512 components, 127 pins per component, and boards as large as 25 by 25 inches; there is no limit on the amount of pins per wire string. Other features are user-defined macros, named and unnamed strings, the ability to define arbitrary pinouts for components, adjustable scale factor, and batch or interactive mode operation. Requirements include PC-DOS 2.01, 128K bytes of RAM, IBM color monitor adapter, a floppy-disk drive, and a printer. It costs $149. Contact Starbow Software, 10403 Caminito Banyon, San Diego, CA 92131, (619) 578-4893.

Circle 632 on inquiry card.

WHERE DO NEW PRODUCT ITEMS COME FROM?
The new products listed in this section of BYTE are culled from the thousands of press releases, letters, and telephone calls we receive each month from manufacturers, distributors, designers, and readers. The basic criteria for selection for publication are (a) does a product match our readers' interests, and (b) is it new or is it simply a reintroduction of an old item. Because of the volume of submissions we must sort through every month, the items we publish are based on vendors' statements and are not individually verified. If you want your product to be considered for publication (at no charge), send full information about it, including the price and an address and telephone number where a reader can get further information, to New Products Editor, BYTE, POB 372, Hancock, NH 03449.

Color Painting with Junior

IBM's PCjr ColorPaint is a graphic-design cartridge that lets you devise freestyle artwork in full color. It allows you to use your mouse to draw pictures and paint in a variety of brush styles and patterns, with 16-color palettes. You can copy and move any component in your drawings, and completed works can be printed. ColorPaint requires a 128K-byte PCjr, DOS 2.1, and the PCjr-compatible serial interface mouse. The price is $99. Contact IBM Corp., Entry Systems Division, POB 1328, Boca Raton, FL 33432.

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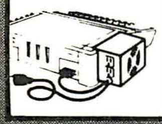
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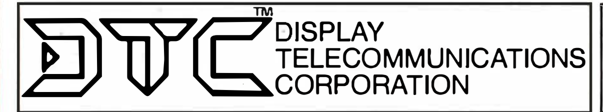
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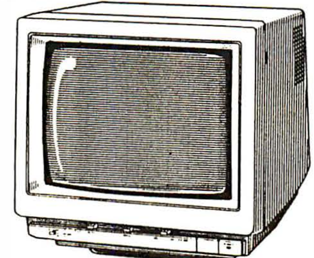
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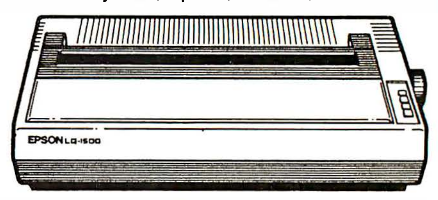
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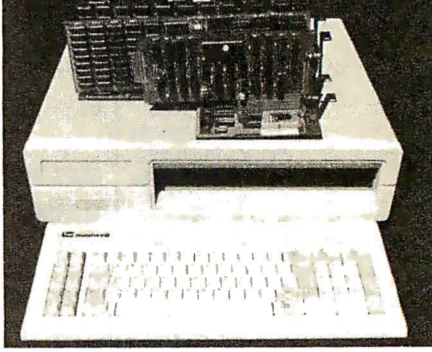
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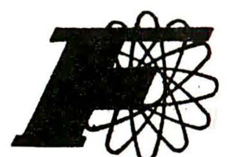
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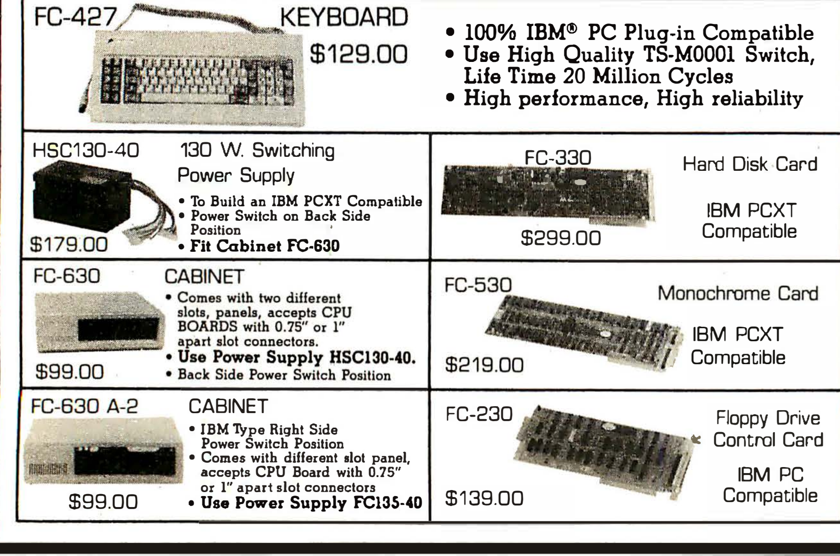
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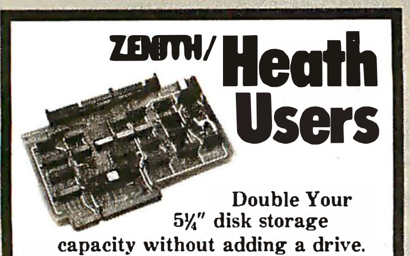
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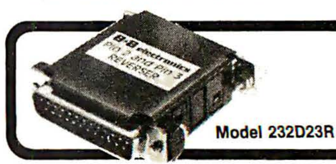
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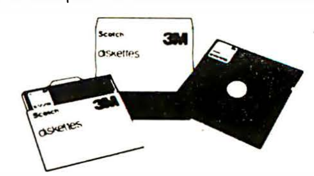
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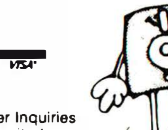
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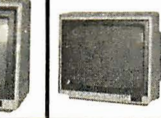
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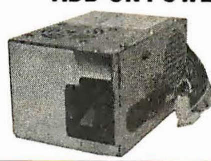
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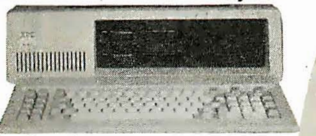
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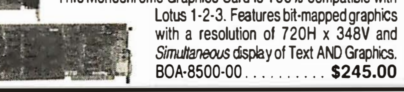
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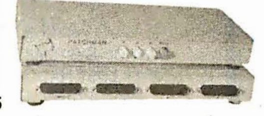
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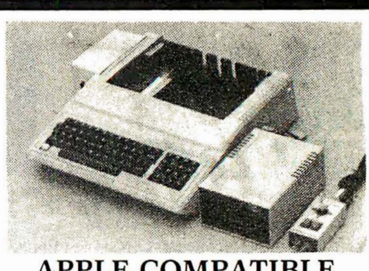
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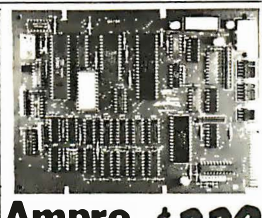
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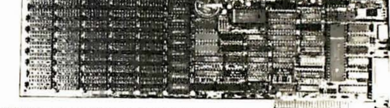
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DB25S female	CND-25S	2.95	2.55	1.65
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SHUGART SA455 Half Height	189	179	175
PANASONIC JA551/2N (455)	139	135	129
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	One	Two	Ten
SHUGART SA851R	495	485	475
QUME 842 "QUME TRACK 8"	459	459	449
TANDON 848E-2 Half Height	459	447	435
REMEX RFD-4000	219	219	209
MITSUBISHI M2894-63	447	439	433
MITSUBISHI M2896-63 ½ Ht.	459	449	409



FREE

Plastic library case supplied with all diskettes purchased from California Digital.

DISKETTES AS LOW AS $16.50

FIVE INCH SINGLE SIDED DOUBLE DENSITY

	Soft Sector / Ten Sector / Sixteen	Each box	10 Boxes	100 Boxes
CAL DIGITAL	CAL-501 / CAL-510 / CAL-516	18.95	17.50	16.50
SCOTCH	MMM-744/0 / MMM-744/10 / MMM-744/16	24.95	22.75	21.75
VERBATIM	VRB-525/01 / VRB-525/10 / VRB-525/16	24.95	22.75	21.75
MEMOREX	MRX-3401 / MRX-3403 / MRX-3485	24.95	21.75	17.75
MAXELL	MXL-MD1 / MXL-MH1/10 / MXL-MH1/16	24.95	22.75	21.25
DYSAN	DYS-104/1D / DYS-107/1D / DYS-105/1D	35.00	33.00	30.50

FIVE INCH DOUBLE SIDED DOUBLE DENSITY

CAL DIGITAL	CAL-551 / CAL-561 / N/A	24.95	22.75	20.50
SCOTCH	MMM-745/0 / MMM-745/10 / MMM-745/16	37.95	35.95	31.25
VERBATIM	VRB-550/01 / VRB-550/10 / VRB-550/16	37.95	35.95	32.75
MEMOREX	MRX-3401 / MRX-3403 / MRX-3485	32.95	31.25	26.25
MAXELL	MXL-MD2 / MXL-MD2/10 / MXL-MD2/16	37.95	35.95	33.75
MAXELL / 96	MXL-MD2/96 / N/A / N/A	45.00	43.00	41.25
DYSAN	DYS-104/2D / DYS-107/2D / DYS-105/2D	42.50	40.50	35.50
DYSAN / 96	DYS-204/2D / N/A / N/A	49.95	47.95	45.75

EIGHT INCH SINGLE SIDED SINGLE DENSITY

SCOTCH	MMM-740/0	28.50	27.50	23.80
MEMOREX	MRX-3062	27.75	26.60	22.25
VERBATIM	VRB-34/9000	31.50	29.50	25.60
DYSAN	DYS-3740/1	35.75	32.75	29.75

EIGHT INCH SINGLE SIDED DOUBLE DENSITY

SCOTCH	MMM-741/0	33.95	31.75	29.15
MEMOREX	MRX-3090	31.95	27.75	26.15
VERBATIM	VRB-34/8000	35.25	33.25	28.75
DYSAN	DYS-3740/1D	40.75	38.75	32.25
MAXELL	MXL-FD1	45.50	39.75	35.15

EIGHT INCH DOUBLE SIDED DOUBLE DENSITY

SCOTCH	MMM-743/0	45.95	43.25	37.50
MEMOREX	MRX-3102	37.95	36.75	31.50
VERBATIM	VRB-34/4001	41.75	37.50	32.25
DYSAN	DYS-3740/2D	54.65	49.75	40.50
MAXELL	MXL-FD2	52.50	48.75	40.45

$49 Apple Macintosh Diskettes





Shipping: First five pounds $3.00, each additional pound $.50. Foreign orders: 10% shipping, excess will be refunded. California residents add 6½% sales tax. • COD's discouraged. Open accounts extended to state supported educational institutions and companies with a strong "Dun & Bradstreet" rating.



California Digital

17700 Figueroa Street • Carson, California 90248

NEC RGB COLOR MONITOR $259



The NEC JC-1401D is a 13" medium/high resolution RGB monitor suitable for use with the Sanyo MBC-550/555 or the IBM/PC. The monitor features a resolution of 400 dots by 240 lines. Colors available are Red. Green. Blue. Yellow. Cyan. Magenta. Black and White.
These monitors are currently being used in applications far more critical than microcomputers.
The NEC monitor carries the Litton-Monroe label and was originally scheduled for use in their "Office of the Future" equipment. A change in Monroe's marketing strategy has made these units excess inventory which were sold to California Digital. We are offering these prime "new" RGB monitors at a fraction of their original cost. Sanyo compatible NEC-1401/S. IBM/P/C Computer compatible NEC-1401/PC

Return of a Smash Hit Sellout DRAGON $139

Compatible with the Radio Shack Color Computer. The world famous Dragon computer is now available in the United States. Manufactured by the Tano Corp. under license of the British Broadcasting Company. The Dragon comes complete with 64K Byte of memory, serial modem port along with a Centronics printer interface. This unique microcomputer features Motorola's advanced 6809E microprocessor and comes standard with Microsoft Color Basic, database manager, and a complete word processing package. The computer outputs color composite video along with R.F. video that allows the unit to be used in conjunction with any color television. This is the Ideal low cost computer to be used with any dial up information system such as the Source, Western Union's EasyLink or any other time share service.
California Digital has agreed to act as exclusive agent for North America in an effort to assist The Tano Corporation in reducing their overstock. For a limited time California Digital can offer the Dragon computer for only $139.

MONITORS

BMC 12A green phosphor 15 MHz composit video	BMC-12A	7895
BMC 12 high resolution. 20MHz	BMC-12EN	119 00
Amdek 300G 12 green phosphor	AMK-300G	128 95
Amdek 300A 12 amber phos hi-resolution	AMK-300A	138 95
Amdek 310A designed for IBM/PC amber	AMK-310A	158 95
Zenith ZVM122 Amber Phosphor 12 40/80 column switch	ZTH-122	94 95
Zenith ZVM123 green phosphor 12 40/80 column switch	ZTH-Z123	94 95
NEC JB1201 green phosphor 18 MHz composit video	NEC-JB1201	159 00
NEC JB1260 commercial grade composit	NEC-JB1260	119 00
Motorola 23 open frame blk/white composit video	MOT-BW23	15900
Conrac 9 open frame requires horz sync & 12v supply	CON-BW9	5900

COLOR

NEC JC1401D Medium/High 13 RGB	NEC-1401/X	25900
BMC AU9191U Color composit video with sound	BMC-9191	238 95
BMC 9191M RGB designed for use with the IBM computer	BMC-9191M	37900
NEC JC1203DM. RGB color monitor	NEC-1203	69900
NEC JC1201 color composit	NEC-JC1201	33900
Zenith ZVM135 RGB & composite suitable for IBM PC	ZTH-Z135	47500
Amdek Color I 13 composit video	AMK-100	299 00
Amdek Color II 13 RGB hi/resolution	AMK-200	419 95
Amdek Color III 13 RGB. medium resolution	AMK-300	359 95
Princeton HX-12 RGB IBM/PC compatible	PRN-HX12	478 95

MODEMS $319



The CTS212AH Modem is 300/1200 Auto Answer/Auto Dial. Hayes Compatible Mycroft Labs Companion communications software $35 00 additional

CTS 212AH 1200 baud. auto dial	CTS-212AH	319 00
Signalman Mark 12. 1200 baud. Hayes compatible.	SGL-MK12	259 00
Signalman Mark 1. direct connect with terminal cable	SGL-MK1	75.00
Hayes Smart Modem 1200 baud. auto answer. auto dial	HYS-212AD	479 00
Hayes 1200B for use with the IBM/PC. 1200 baud.	HYS-1200B	429 00
Hayes Smartmodem. 300 baud only. auto answer. auto dial	HYS-103AD	229.00
Hayes Micromodem II. 103 Apple direct connect	HYS-MM2	279 00
Hayes Chronograph. time & date	HYS-CHR232	199 00
U.S. Robotics 212A 300/1200 baud. auto dial/answer	USR-212A	439.00
U.S. Robotics Password 300/1200 baud	USR-PW212	389.00
Penril 300/1200 industrial quality	PEN-12AD	595 00
Universal Data 103LP. line power. answer & originate	UDS-103LP	169 00
Universal Data 202. 1200 baud. half duplex only	UDS-202LP	219 00
Universal Data 212LP. full 1200 baud duplex. line power	UDS-212LP	359 00
Novation J Cat. direct connect. auto answer	NOV-JCAT	115 00
Novation SmartCat 103/212. 1200 baud auto dial	NOV-SC212	529 00

ASCII KEYBOARD $49



California Digital has purchased over 3000 of these Microswitch keyboards from the General Dynamics Corporation 93 ASCII encoded Hall effect switches includes 8 function keys and 14 key numeric cluster make this keyboard an excellect value at only $49 MIC-93GD 5 lbs
We also have available a matching General Dynamics steel trim panel $10

Non-encoded Hytek 58 key metal contact keyboard HIK-58 $24 95 Matching 15 key numeric cluster $9 95 HIK-15 Both for only $29 95 HIK-5815

PRINTERS

MATRIX PRINTERS

StarGemini-10X 120 char/sec	STR-G10X	27900
Star Gemini-15X. 100 char/sec 15 paper	STR-G15X	38900
StarGeminiDelta 10. 160Char/sec	STR-D10	39900
Star Coex 80FT friction& tractor	VST-C80FT	195 00
Toshiba P1351. 192 char/sec letter quality	TOS-1351	149500
Okidata 82A serial & parallel 9½ paper	OKI-82A	34700
Okidata 92A parallel interface. 160 char/sec	OKI-92A	42700
Okidata 83A & parallel 15 paper	OKI-83A	56700
Okidata 84A & parallel 15 paper	OKI-84A	99700
Okidata 2350 (new) 350 char/sec	OKI-2350	199500
Epson RX-8010 120 Char/sec	EPS-RX80	317 00
Epson FX80 10 160 char/sec with graphtrax	EPS-FX80	52900
Epson FX 100 15 160 char/sec with graphtrax	EPS-FX100	71900
Anadex 9501B high speed with graphics	ADX-9501B	102900
Anadex 9620B 200 char/sec par l & serial	ADX-9620B	112900
Prowriter 8510 parallel 9½ paper	PRO-8510P	35900
Prowriter II parallel 15 paper. graphics	PRO-2P	68900
Dataproducts B-800-3. bandprinter 600 LPM	DPS-B600	698500
Printronix P300 high speed printer 300 lines per minute	PTX-P300	399500
Printronix P600 ultra high speed 600 lines per minute	PTX-P600	579500

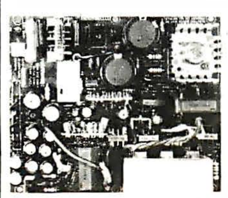
WORD PROCESSING PRINTERS

NEC7710 55 char/second. serial interface	NEC-7710	179500
NEC7730 55 char/sec. par l interface	NEC-7730	179500
NEC3550 popular printer designed for the IBM PC	NEC-3550	159900
NEC2050 designed for IBM/PC 20 char/sec par l	NEC-2050	99500
Silver Reed EXP500 14 char/sec. par l interface	SRD-EXP500	45900
Silver Reed EXP550 17 Char/sec par l interface	SRD-EXP550	65900
Diablo 630 40 char/sec serial	DBL-630	176500
Diablo 620. proportional spacing horz & vert tab 20 cps	DBL 620	87900
Juki 6100. 18 char/sec SPECIAL	JUK-S6100	31900
Brother HR1A serial interface	BTH-HR1S	69500
Starwriter F10 serial 40char sec	PRO-F10S	112500
Starwriter F10 parallel 40 char/sec	PRO-F10P	112500
Comrex CR2. 5k buffer. proportional spacing par l	CRX CR2P	49500

TERMINALS

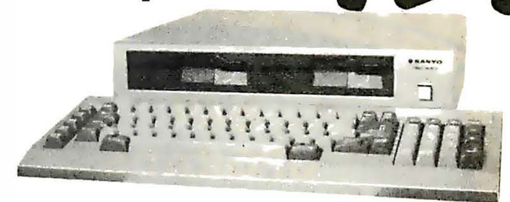
Freedom 100. split screen. detatchable keyboard	LIB-F100	495 00
Quine 102 green phosphor terminal	QUM-102	53900
Ampex Dialogue 125 green screen.	APX-D125G	67500
Ampex Dialouge 175 amber screen. two page. func keys	APX-D175A	71900
Wyse 50. 14" green phosphor	WYS-50	59500
Wyse 300. Eight color display. split screen	WYS-300	115900
Zenith 29 terminal. VT52 compatible detatchable keyboard	ZTH-Z29	765 00
Televideo 910 Plus. block mode	TVI-910P	57500
Televideo 925. detatchable keyboard. 22 function keys	TVI-925	75900
Televideo 950. graphicchar..split screen. 22 func	TVI-950	95000
Televideo970. 14" green. 132 column. European	TVI-970	1095.00

Switching Supply $49



Power your single board system with one supply! This Kepro switcher power supply outputs +5 volts at 5 amps, + 12 volts at 1.8 amps, 2.8 amps surge, − 12 volts at 0.5 amps, and a second + 12 volts at 2.0 amp output. It is jumper selectable for both 120 volt and 220 volt operation. Units measures approximately 6" by 8". This board is capable of supplying power for two 5¼" Winchesters, a single board computer along with a hard disk controller. Also suitable for use with all IBM look-a-likes. Priced at only $49.95 this power supply offers excellent value along with high reliability. KPT-512

SANYO IBM Compatible $759

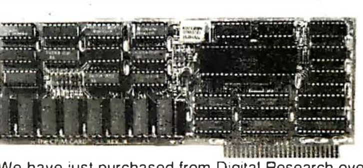


The Sanyo MBC-550 Microcomputer includes 128K byte of memory, a 5¼" disk drive along with a parallel printer port. The computer outputs both RGB color and monochrome composite video. Extensive software such as Sanyo Basic, Wordstar, Calcstar and Easy Writer I is included with the MBC-550.

Sanyo 550	**reduced SALE price**	**759.00**
Sanyo 550 Plus	**two single sided drives**	**829.00**
Sanyo 550-2	**one double sided drive**	**949.00**
Sanyo 550-2 Plus	**two double sided drives**	**1095.00**
Sanyo 555	**two sgl. drives, bonus soft.**	**1095.00**
Sanyo 555-2	**two dbl. drives, bonus soft.**	**1249.00**
Memory Upgrade	**256K total memory**	**99.00**
Serial Card	**modem interface**	**85.00**

Advanced Logic Systems CP/M 3.0 CARD $179

Includes Digital Research C/PM Plus



We have just purchased from Digital Research over eight hundred of the Advanced Logic Systems CP/M 3.0 cards. This unique product offers performance upto 300% faster than existing Apple CP/M cards.
Featuring a 6 MHz. Z80B micro-processor. 64K/Byte of on board memory, with CP/M 3.0 along with GSX 80 graphics and CBasic. The ALS card supports larger programs with enhanced CP/M editing features.
Manufacturers suggested price on the CP/M board is $399. while supplies last California Digital is offering this card at only $179. ALS-Z80



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PIPELINE COMPUTERS

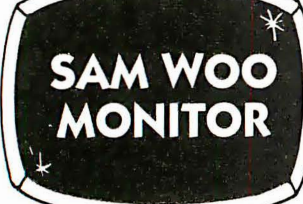
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★ 310A Compatible
★ Hi-Res. Amber

$99



★ 1 - 320K Drive
★ Controller
★ 64K, Keyboard
★ 90 Day Warr. w/Pipeline

$1399



★ 256K, 2-Drives
★ Amber Monochrome Monitor
★ Monochrome Adaptor
★ 90 Day Warr. w/Pipeline

$1949



★ 35 cps Letter Quality
★ PC Plug Compatible

$1650

Tractor **$199**

The Source!



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- Purchase Orders Accepted
- This Ad Supersedes all Others

Prices Subject to Change

The Source!



Circle 275 on inquiry card.



STATIC RAMS

2101	256 x 4 (450ns)	1.90
5101	256 x 4 (450ns) (cmos)	3.90
2102-1	1024 x 1 (450ns)	.88
2102L-4	1024 x 1 (450ns) (LP)	.98
2102L-2	1024 x 1 (250ns) (LP)	1.45
2111	256 x 4 (450ns)	2.45
2112	256 x 4 (450ns)	2.95
2114	1024 x 4 (450ns)	.99
2114-25	1024 x 4 (250ns)	1.10
2114L-4	1024 x 4 (450ns) (LP)	1.20
2114L-3	1024 x 4 (300ns) (LP)	1.30
2114L-2	1024 x 4 (200ns) (LP)	1.40
2125	1024 x 1	2.49
2147	4096 x 1 (55ns)	4.90
TMS4044-4	4096 x 1 (450ns)	3.45
TMS4044-3	4096 x 1 (300ns)	3.95
TMS4044-2	4096 x 1 (200ns)	4.45
MK4118	1024 x 8 (250ns)	9.90
TMM2016-200	2048 x 8 (200ns)	4.10
TMM2016-150	2048 x 8 (150ns)	4.90
TMM2016-100	2048 x 8 (100ns)	6.10
HM6116-4	2046 x 8 (200ns) (cmos)	4.70
HM6116-3	2048 x 8 (150ns) (cmos)	4.90
HM6116-2	2046 x 8 (120ns) (cmos)	8.90
HM6116LP-4	2046 x 8 (200ns) (cmos)	5.90
HM6116LP-3	2048 x 8 (150ns) (cmos)(LP)	6.90
HM6116LP-2	2048 x 8 (120ns) (cmos)(LP)	9.95
Z-8132	4096 x 8 (300ns) (Qstat)	33.95
HM6264P-15	8192 x 8 (150ns) (cmos)	38.95
HM6264LP-15	8192 x 8 (150ns) (cmos)	48.95

LP = Low Power Qstat = Quasi-Static

DYNAMIC RAMS

TMS4027	4096 x 1 (250ns)	1.95
UPD411	4096 x 1 (300ns)	2.95
MM5280	4096 x 1 (300ns)	2.95
MK4108	8192 x 1 (200ns)	1.90
MM5298	8192 x 1 (250ns)	1.80
4116-200	16384 x 1 (200ns)	.79
4116-150	16384 x 1 (150ns)	1.20
2118	18384 x 1 (150ns) (5v)	4.90
4164-250	85538 x 1 (250ns)	4.45
4164-200	65538 x 1 (200ns) (5v)	5.45
4164-150	65538 x 1 (150ns) (5v)	6.45

5V = Single 5 Volt Supply

EPROMS

1702	258 x 8 (1us)	4.45
2708	1024 x 8 (450ns)	2.49
2758	1024 x 8 (450ns)	2.49
2758	1024 x 8 (450ns) (5v)	5.90
2716	2048 x 8 (450ns) (5v)	2.95
2718-1	2048 x 8 (350ns) (5v)	5.90
TMS2516	2048 x 8 (450ns) (5v)	5.45
TMS2718	2048 x 8 (450ns)	7.90
TMS2532	4096 x 8 (450ns) (5v)	5.90
2732	4098 x 8 (450ns) (5v)	4.45
2732-250	4098 x 8 (250ns) (5v)	8.45
2732-200	4098 x 8 (200ns) (5V)	11.45
2764	8192 x 8 (450ns) (5v)	8.45
2764-250	8192 x 8 (250ns) (5v)	7.45
2784-200	8192 x 1 (200ns) (5v)	16.45
TMS2564	8192 x 8 (450ns) (5v)	14.45
MC68764	8192 x 8 (450ns) (5v) (24 pin)	38.95
27128	16384 x 8 Call	24.45

5v = Single 5 Volt Supply

74LS00

74LS00	.23	74LS173	.68
74LS01	.24	74LS174	.54
74LS02	.24	74LS175	.54
74LS03	.24	74LS181	2.10
74LS04	.23	74LS189	8.90
74LS05	.24	74LS190	.88
74LS08	.27	74LS191	.88
74LS09	.28	74LS192	.78
74LS10	.24	74LS193	.78
74LS11	.34	74LS194	.68
74LS12	.34	74LS195	.68
74LS13	.44	74LS196	.78
74LS14	.58	74LS197	.78
74LS15	.34	74LS221	.88
74LS20	.24	74LS240	.94
74LS21	.28	74LS241	.98
74LS22	.24	74LS242	.98
74LS26	.28	74LS243	.98
74LS27	.28	74LS244	1.25
74LS28	.34	74LS245	1.45
74LS30	.24	74LS247	.74
74LS32	.28	74LS248	.98
74LS33	.54	74LS249	.98
74LS37	.34	74LS251	.58
74LS38	.34	74LS253	.58
74LS40	.24	74LS257	.58
74LS42	.48	74LS258	.58
74LS47	.74	74LS259	2.70
74LS48	.74	74LS260	.58
74LS49	.74	74LS266	.54
74LS51	.24	74LS273	1.45
74LS54	.28	74LS275	3.30
74LS55	.28	74LS279	.48
74LS63	1.20	74LS280	1.95
74LS73	.38	74LS283	.68
74LS74	.34	74LS290	.88
74LS75	.38	74LS293	.88
74LS78	.38	74LS295	.98
74LS78	.48	74LS298	.88
74LS83	.59	74LS299	1.70
74LS85	.68	74LS323	3.45
74LS86	.38	74LS324	1.70
74LS90	.54	74LS352	1.25
74LS91	.88	74LS353	1.25
74LS92	.54	74LS363	1.30
74LS93	.54	74LS364	1.90
74LS95	.74	74LS365	.48
74LS96	.88	74LS366	.48
74LS107	.38	74LS367	.44
74LS109	.38	74LS368	.44
74LS112	.38	74LS373	1.35
74LS113	.38	74LS374	1.35
74LS114	.38	74LS377	1.35
74LS122	.44	74LS378	1.13
74LS123	.78	74LS379	1.30
74LS124	2.85	74LS385	1.85
74LS125	.48	74LS386	.44
74LS126	.48	74LS390	1.15
74LS132	.58	74LS393	1.15
74LS133	.58	74LS395	1.15
74LS136	.38	74LS399	1.45
74LS137	.98	74LS424	2.90
74LS138	.54	74LS447	.36
74LS139	.54	74LS490	1.90
74LS145	1.15	74LS624	3.95
74LS147	2.45	74LS640	2.15
74LS148	1.30	74LS645	2.15
74LS151	.54	74LS668	1.65
74LS153	.54	74LS669	1.85
74LS154	1.85	74LS670	1.45
74LS155	.68	74LS674	9.60
74LS156	.68	74LS682	3.15
74LS157	.64	74LS683	3.15
74LS158	.58	74LS684	3.15
74LS160	.68	74LS685	3.15
74LS161	.64	74LS688	2.35
74LS162	.68	74LS689	3.15
74LS163	.64	74LS783	23.95
74LS164	.68	81LS95	1.45
74LS165	.94	81LS96	1.45
74LS166	1.90	81LS97	1.45
74LS168	1.70	81LS98	1.45
74LS169	1.70	25LS2521	2.75
74LS170	1.45	25LS2569	4.20

7400

7400	.18	7482	.94	74172	5.90
7401	.18	7483	.49	74173	.74
7402	.18	7485	.58	74174	.88
7403	.18	7486	.34	74175	1.75
7404	.18	7489	2.10	74176	.88
7405	.24	7490	.34	74177	.74
7406	.28	7491	.39	74178	1.10
7407	.28	7492	.49	74179	1.70
7408	.23	7493	.34	74180	.74
7409	.18	7494	.64	74181	2.20
7410	.18	7495	.54	74182	.74
7411	.24	7496	.69	74184	1.95
7412	.29	7497	2.70	74185	1.95
7413	.34	74100	1.70	74190	1.10
7414	.48	74107	.29	74191	1.10
7416	.24	74109	.44	74192	.78
7417	.24	74110	.44	74193	.78
7420	.18	74111	.54	74194	.84
7421	.34	74116	1.50	74195	.84
7422	.34	74120	1.15	74196	.78
7423	.28	74121	.28	74197	.74
7425	.28	74122	.44	74198	1.34
7426	.28	74123	.48	74199	1.34
7427	.28	74125	.44	74221	1.34
7428	.44	74126	1.44	74246	1.34
7430	.18	74128	.54	74247	1.24
7432	.28	74132	.44	74248	1.80
7433	.44	74136	.49	74249	1.90
7437	.28	74141	.64	74251	.74
7438	.28	74142	2.90	74259	2.20
7440	.18	74143	2.90	74265	1.30
7442	.48	74145	.59	74273	1.90
7443	.64	74147	1.75	74276	1.20
7444	.68	74148	1.75	74279	.74
7445	.68	74150	1.30	74283	1.95
7446	.68	74151	.54	74284	3.70
7447	.68	74152	.64	74285	3.70
7448	.68	74153	.54	74290	.94
7450	.18	74154	1.20	74293	.74
7451	.22	74155	.74	74298	.84
7453	.22	74156	.64	74351	2.20
7454	.22	74157	.54	74365	.64
7460	.22	74159	1.60	74366	.64
7470	.34	74160	.84	74367	.64
7472	.28	74161	.68	74368	.64
7473	.33	74162	.84	74376	2.15
7474	.32	74163	.68	74390	1.70
7475	.44	74164	.84	74393	1.30
7476	.34	74165	.84	74425	3.10
7480	.58	74166	.95	74426	.84
7481	1.05	74167	2.90	74490	2.50
		74170	1.60		

6500

1 Mhz

6502	4.90
6504	6.90
6505	8.90
6507	9.90
6520	4.30
6522	6.90
6532	9.90
6545	21.50
6551	10.85

2 Mhz

6502A	6.90
6522A	9.90
6532A	10.95
6545A	26.95
6551A	10.95

3 Mhz

65028	9.90

6800

68000	58.95
6800	3.90
6802	7.90
6808	12.90
6809E	18.95
6809	10.95
6810	2.90
6820	4.30
6821	3.20
5628	13.95
6840	11.95
6843	33.95
6844	24.95
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5847	10.95
6850	3.20
6852	15.70
6860	9.90
6862	10.95
6875	6.90
6880	2.20
6883	21.95
68047	23.95
68488	18.95

1 Mhz

68800	9.95
68802	21.25
68809E	26.95
68809	28.95
68810	6.90
68821	6.90
68845	18.95
68850	5.90

74S00

74S00	.31	74S163	1.9
74S02	.34	74S168	3.9
74S03	.34	74S169	3.9
74S04	.34	74S174	.9
74S05	.34	74S175	.9
74S08	.34	74S181	3.9
74S09	.39	74S182	2.9
74S10	.34	74S188	1.9
74S11	.34	74S189	6.9
74S15	.34	74S194	1.4
74S20	.34	74S195	1.4
74S22	.34	74S196	1.4
74S30	.34	74S197	1.4
74S32	.39	74S201	6.9
74S37	.87	74S225	7.9
74S38	.84	74S240	2.1
74S40	.34	74S241	2.1
74S51	.34	74S244	2.1
74S64	.39	74S251	.9
74S65	.39	74S253	.9
74S74	.49	74S257	.9
74S85	1.94	74S258	.9
74S86	.49	74S260	.7
74S212	.49	74S274	19.9
74S113	.49	74S275	19.9
74S114	.54	74S280	1.9
74S124	2.70	74S287	1.8
74S132	1.20	74S288	1.8
74S133	.44	74S289	6.8
74S134	.49	74S301	6.9
74S135	.88	74S373	2.4
74S138	.84	74S374	2.4
74S139	.84	74S381	7.9
74S140	.54	74S387	1.9
74S151	.94	74S412	2.9
74S153	.94	74S471	4.9
74S157	.94	74S472	4.9
74S158	.94	74S474	4.9
74S161	1.90	74S482	15.2
74S162	1.90	74S570	2.9

8000

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INS-8073	49.95	8156	6.9
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8085	5.90	8185-2	38.9
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8086	28.95	8748	49.9
8087	199.00	8755	23.9
8088	38.95		

8200

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8203	38.95
8205	3.45
8212	1.75
8214	3.80
8218	1.70
8224	2.20
8228	1.75
8228	3.45
8237	18.95
8237-5	20.95
8238	4.45
8243	10.95
8250	18.95
8251	4.45
8253	8.90
8253-5	7.90
8255	4.45
8255-5	5.20
8257	7.90
8257-5	8.90
8259	8.85
8259-5	7.45
8271	75.00
8272	38.95
8275	28.95
8279	8.90
8279-5	9.00
8282	6.45
8283	8.45
8284	14.95
8288	8.45
8287	8.45
8288	24.00
8289	48.95
8292	16.95

Z-80

2.5 MHZ

Z80-CPU	3.
Z80-CTC	3.
Z80-DART	10.
Z80-DMA	13.
Z80-PIO	3.
Z80-SIO/0	11.
Z80-SIO/1	11.
Z80-SIO/2	11.
Z80-SIO/9	11.

4.0 MHZ

Z80A-CPU	4.
Z80A-CTC	4.
Z80A-DART	9.
Z80A-DMA	12.
Z80A-PIO	4.
Z80A-SIO/0	12.
Z80A-SIO/1	12.
Z80A-SIO/2	12.
Z80A-SIO/9	12.

6.0 MHZ

Z80B-CPU	9.
Z80B-CTC	12.
Z80B-PIO	12.
Z80B-DART	12

ZILOG

Z6132	33
Z8671	38

INTERFACE CHIPS

8T26	1.54	8T98	
68T28	1.84	DM8131	2.
8T95	.88	DP8304	2.
8T96	.88	DS8835	1.
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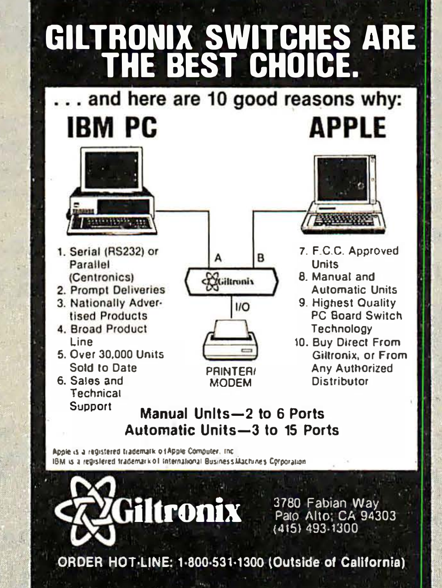
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AMDEK COLOR IV	995	499.95
PGS MAX-12	269	199.95
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PGS SR-12	799	649.95
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MULTIPLAN	250	169.95
ACCOUNTING PARTNER	395	249.95
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PROKEY	129	99.95
MULTIMATE	495	299.95
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TRANSEND PC	189	139.95

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	LIST	JADE
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MOUSE	199	129.95
SYSTEM CARD 64K	395	279.95
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QUADNET VI	1995	1659.95
QUADNET IV	2295	1989.95
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MEGA PLUS 256K	665	429.95
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MP PLUS 192K	495	299.95
MP PLUS 256K	595	349.95
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MP II 128K	445	299.95
MP II 192K	545	349.95
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MP II 384K	845	499.95

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HERCULES GRAPHIC	499	339.95
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QUADCOLOR II	275	209.95
AMDEK MAI	649	449.95
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QUADBOARD 256K	595	399.95
QUADBOARD 384K	795	595.95
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Tractor for 500	159	129.95
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Parallel in/Serial out	LIST	JADE
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32K	260	199.95

Serial in/Serial out	LIST	JADE
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Serial, 16K	259	189.95
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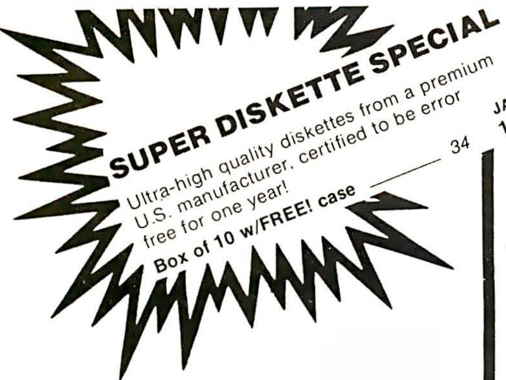
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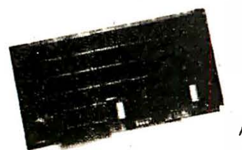
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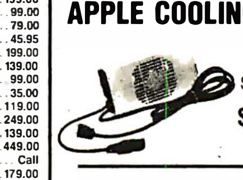
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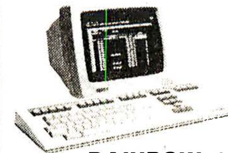
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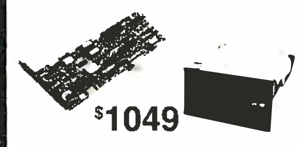
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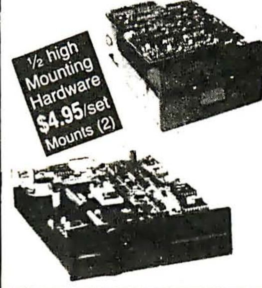
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Dbl/Dbl	40	100 for 360

DISK ACCESSORIES

Verbatim

8" or 5¼" Head Cleaning Kit	$ 9

Flip Tub

5¼" Holds 50 disks, plexiglass	17
5¼" Holds 70 disks, plexiglass	21

MODEMS

Hayes Micro Computer

Smart Modem 300 Baud	$ 205
Smart Modem 1200 Baud	489
Smart Modem 1200B for PC	399
Micro Modem IIE	239

Computer Components Unlimited

A California Corporation

RETAIL STORE:
11976 Aviation Blvd.
Inglewood, CA 90304

MAIL ORDER:
P.O. Box 1936
Hawthorne, CA 90250

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This Ad Supersedes All Others

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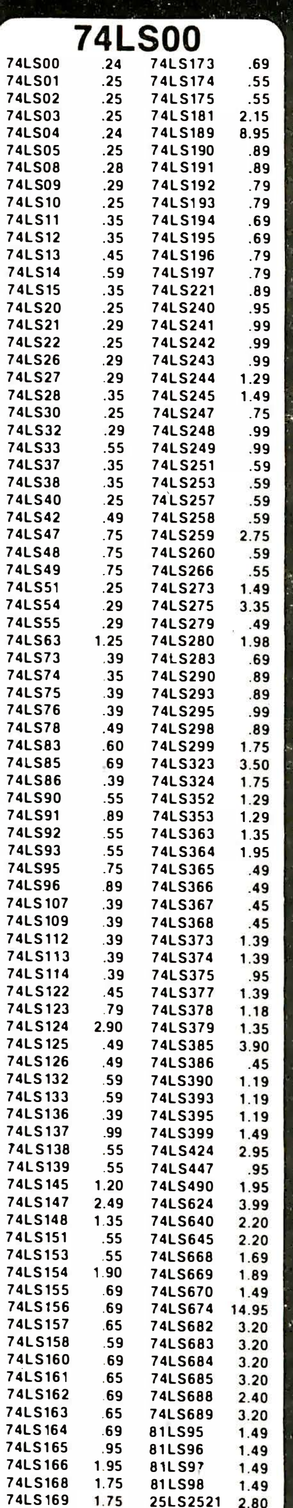
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All merchandise new. We accept MC, Visa, Wire Transfer, COD Call, Certified Check, P.O.'s from qualified firms, APO accepted. Shipping: Minimum $4.50 first 5 pounds. Tax: California Res. Only add 6½% sales tax. All returns subject to 15% restocking charge. Prices Subject to Change.

Circle 55 on inquiry card.

Circle 188 on inquiry card.

41256 256K DYNAMIC 200ns 39.95 HM6264-15 8Kx8 STATIC 150ns 37.95



74LS00

74LS00	.24	74LS173	.69
74LS01	.25	74LS174	.55
74LS02	.25	74LS175	.55
74LS03	.25	74LS181	2.15
74LS04	.24	74LS189	8.95
74LS05	.25	74LS190	.89
74LS08	.28	74LS191	.89
74LS09	.29	74LS192	.79
74LS10	.25	74LS193	.79
74LS11	.35	74LS194	.69
74LS12	.35	74LS195	.69
74LS13	.45	74LS196	.79
74LS14	.59	74LS197	.79
74LS15	.35	74LS221	.89
74LS20	.25	74LS240	.95
74LS21	.29	74LS241	.99
74LS22	.25	74LS242	.99
74LS26	.29	74LS243	.99
74LS27	.29	74LS244	1.29
74LS28	.35	74LS245	1.49
74LS30	.25	74LS247	.75
74LS32	.29	74LS248	.99
74LS33	.55	74LS249	.99
74LS37	.35	74LS251	.59
74LS38	.35	74LS253	.59
74LS40	.25	74LS257	.59
74LS42	.49	74LS258	.59
74LS47	.75	74LS259	2.75
74LS48	.75	74LS260	.59
74LS49	.75	74LS266	.55
74LS51	.25	74LS273	1.49
74LS54	.29	74LS275	3.35
74LS55	.29	74LS279	.49
74LS63	1.25	74LS280	1.98
74LS73	.39	74LS283	.69
74LS74	.35	74LS290	.89
74LS75	.39	74LS293	.89
74LS76	.39	74LS295	.99
74LS78	.49	74LS298	.89
74LS83	.60	74LS299	1.75
74LS85	.69	74LS323	3.50
74LS86	.39	74LS324	1.75
74LS90	.55	74LS352	1.29
74LS91	.89	74LS353	1.29
74LS92	.55	74LS363	1.35
74LS93	.55	74LS364	1.95
74LS95	.75	74LS365	.49
74LS96	.89	74LS366	.49
74LS107	.39	74LS367	.45
74LS109	.39	74LS368	.45
74LS112	.39	74LS373	1.39
74LS113	.39	74LS374	1.39
74LS114	.39	74LS375	.95
74LS122	.45	74LS377	1.39
74LS123	.79	74LS378	1.18
74LS124	2.90	74LS379	1.35
74LS125	.49	74LS385	3.90
74LS126	.49	74LS386	.45
74LS132	.59	74LS390	1.19
74LS133	.59	74LS393	1.19
74LS136	.39	74LS395	1.19
74LS137	.99	74LS399	1.49
74LS138	.55	74LS424	2.95
74LS139	.55	74LS447	.95
74LS145	1.20	74LS490	1.95
74LS147	2.49	74LS624	3.99
74LS148	1.35	74LS640	2.20
74LS151	.55	74LS645	2.20
74LS153	.55	74LS668	1.69
74LS154	1.90	74LS669	1.89
74LS155	.69	74LS670	1.49
74LS156	.69	74LS674	14.95
74LS157	.65	74LS682	3.20
74LS158	.59	74LS683	3.20
74LS160	.69	74LS684	3.20
74LS161	.65	74LS685	3.20
74LS162	.69	74LS688	2.40
74LS163	.65	74LS689	3.20
74LS164	.69	81LS95	1.49
74LS165	.95	81LS96	1.49
74LS166	1.95	81LS97	1.49
74LS168	1.75	81LS98	1.49
74LS169	1.75	25LS2521	2.80
74LS170	1.49	25LS2569	4.25

74S00

74S00	.32	74S124	2.75	74S197	1.49
74S02	.35	74S132	1.24	74S201	6.95
74S03	.35	74S133	.45	74S225	7.95
74S04	.35	74S134	.50	74S240	2.20
74S05	.35	74S135	.89	74S241	2.20
74S08	.35	74S138	.85	74S244	2.20
74S09	.40	74S139	.85	74S251	.95
74S10	.35	74S140	.55	74S253	.95
74S11	.35	74S151	.95	74S257	.95
74S15	.35	74S153	.95	74S258	.95
74S20	.35	74S157	.95	74S260	.79
74S22	.35	74S158	.95	74S273	2.45
74S30	.35	74S161	1.95	74S280	1.95
74S32	.40	74S162	1.95	74S287	1.90
74S37	.88	74S163	1.95	74S288	1.90
74S38	.85	74S168	3.95	74S289	6.89
74S40	.35	74S169	3.95	74S301	6.95
74S51	.35	74S174	.95	74S373	2.45
74S64	.40	74S175	.95	74S374	2.45
74S65	.40	74S181	3.95	74S387	1.95
74S74	.50	74S182	2.95	74S412	2.98
74S85	1.99	74S188	1.95	74S471	4.95
74S86	.50	74S189	6.95	74S472	4.95
74S112	.50	74S194	1.49	74S474	4.95
74S113	.50	74S195	1.49	74S570	2.95
74S114	.55	74S196	1.49	74S571	2.95

VOLTAGE REGULATORS

7805T	.75	7905T	.85
78M05C	.35	7908T	.85
7808T	.75	7912T	.85
7812T	.75	7915T	.85
7815T	.75	7924T	.85
7824T	.75		
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39	7915K	1.49
7824K	1.39	7924K	1.49
78L05	.69	79L05	.79
78L12	.69	79L12	.79
78L15	.69	79L15	.79
		LM323K	4.95
78H05K	9.95	UA78S40	1.95
78H12K	9.95		

C, T = TO-220 K = TO-3
L = TO-92

7400

7400	.19	74123	.49
7401	.19	74125	.45
7402	.19	74126	.45
7403	.19	74132	.45
7404	.19	74136	.50
7405	.25	74143	4.95
7406	.29	74145	.60
7407	.29	74147	1.75
7408	.24	74148	1.20
7409	.19	74150	1.35
7410	.19	74151	.55
7411	.25	74153	.55
7413	.35	74154	1.25
7414	.49	74155	.75
7416	.25	74157	.55
7417	.25	74159	1.65
7420	.19	74160	.85
7421	.35	74161	.69
7425	.29	74163	.69
7427	.29	74164	.85
7430	.19	74165	.85
7432	.29	74166	1.00
7437	.19	74167	2.95
7438	.29	74170	1.65
7442	.49	74173	.75
7445	.69	74174	.89
7446	.69	74175	.89
7447	.69	74177	.75
7448	.69	74181	2.25
7451	.23	74184	2.00
7473	.34	74185	2.00
7474	.33	74191	1.15
7475	.45	74192	.79
7476	.35	74193	.79
7482	.95	74194	.85
7483	.50	74195	.85
7485	.59	74197	.75
7486	.35	74198	1.35
7489	2.15	74221	1.35
7490	.35	74246	1.35
7492	.50	74247	1.25
7493	.35	74259	2.25
7495	.55	74273	1.95
7497	2.75	74276	1.25
74100	1.75	74279	.75
74107	.30	74366	.65
74109	.45	74367	.65
74116	1.55	74368	.65
74121	.29	74393	1.35
74122	.45		

SOUND CHIPS

76477	3.95	AY3-8910	12.95
76488	5.95	AY3-8912	12.95
76489	8.95	MC3340	1.49
SSI-263	39.95		

BYPASS CAPS

.01 UF DISC	100/6.00
.01 UF MONOLITHIC	100/12.00
.1 UF DISC	100/8.00
.1 UF MONOLITHIC	100/15.00

EPROM ERASERS

SPECTRONICS CORPORATION

	Timer	Capacity Chip	Intensity (uW/Cm²)	
PE-14		9	8,000	83.00
PE-14T	X	9	8,000	119.00
PE-24T	X	12	9,600	175.00
PL-265T	X	30	9,600	255.00
PR-125T	X	25	17,000	349.00
PR-320T	X	42	17,000	595.00

INTERFACE

8T26	1.59
8T28	1.89
8T95	.89
8T96	.89
8T97	.89
8T98	.89
DM8131	2.95
DP8304	2.29
DS8833	2.25
DS8835	1.99
DS8836	.99
DS8837	1.65
DS8838	1.30

VISA

MasterCard

DATA ACQUISITION

ADC0800	15.55	DAC0800	4.95
ADC0804	3.49	DAC0808	2.95
DAC0806	1.95	DAC1020	8.25
ADC0809	4.49	DAC1022	5.95
ADC0816	14.95	MC1408L6	1.95
ADC0817	9.95	MC1408L8	2.95

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RS232 Female	3.25
RS232 Hood	1.25
S-100 ST	3.95

EXAR

XR 2206	3.75
XR 2207	3.75
XR 2208	3.75
XR 2211	5.25
XR 2240	3.25

INTERSIL

ICL7106	9.95
ICL7107	12.95
ICL7660	2.95
ICL8038	3.95
ICM7207A	5.59
ICM7208	15.95

9000

9316	1.00
9334	2.50
9368	3.95
9401	9.95
9601	.75
9602	1.50
96S02	1.95

LINEAR

LM301	.34	LM348	.99	LM567	.89	LM1812	8.25
LM301H	.79	LM350K	4.95	NE570	3.95	LM1830	3.50
LM307	.45	LM350T	4.60	NE571	2.95	LM1871	5.49
LM308	.69	LM358	.69	NE590	2.50	LM1872	5.49
LM308H	1.15	LM359	1.79	NE592	2.75	LM1877	3.25
LM309H	1.95	LM376	3.75	LM709	.59	LM1889	1.95
LM309K	1.25	LM377	1.95	LM710	.75	LM1896	1.75
LM310	1.75	LM378	2.50	LM711	.79	ULN2003	2.49
LM311	.64	LM379	4.50	LM723	.49	LM2877	2.05
LM311H	.89	LM380	.89	LM723H	.55	LM2878	2.25
LM312H	1.75	LM380N-8	1.10	LM733	.98	LM2900	.85
LM317K	3.95	LM381	1.60	LM741	.35	LM2901	1.00
LM317T	1.19	LM382	1.60	LM741N-14	.35	LM2917	2.95
LM318	1.49	LM383	1.95	LM741H	.40	LM3900	.59
LM318H	1.59	LM384	1.95	LM747	.69	LM3905	1.25
LM319H	1.90	LM386	.89	LM748	.59	LM3909	.98
LM319	1.25	LM387	1.40	LM1014	1.19	LM3911	2.25
LM320 (see 7900)		LM389	1.35	LM1303	1.95	LM3914	3.95
LM322	1.65	LM390	1.95	LM1310	1.49	LM3915	3.95
LM323K	4.95	LM392	.69	MC1330	1.69	LM3916	3.95
LM324	.59	LM393	1.29	MC1349	1.89	MC4024	3.95
LM329	.65	LM394H	4.60	MC1350	1.19	MC4044	4.50
LM331	3.95	LM399H	5.00	MC1358	1.69	RC4136	1.25
LM334	1.19	NE531	2.95	MC1372	6.95	RC4151	3.95
LM335	1.40	NE555	.34	LM1414	1.59	LM4250	1.75
LM336	1.75	NE556	.65	LM1458	.59	LM4500	3.25
LM337K	3.95	NE558	1.50	LM1488	.69	RC4558	.69
LM337T	1.95	NE561	24.95	LM1489	.69	LM13080	1.29
LM338K	6.95	NE564	2.95	LM1496	.85	LM13600	1.49
LM339	.99	LM565	.99	LM1558H	3.10	LM13700	1.49
LM340 (see 7800)		LM566	1.49	LM1800	2.37	MPQ2907	1.95

H TO-5 CAN T TO-220 K TO-3

RCA

CA 3023	2.75	CA 3082	1.65
CA 3039	1.29	CA 3083	1.55
CA 3046	1.25	CA 3086	.80
CA 3059	2.90	CA 3089	2.99
CA 3060	2.90	CA 3096	3.49
CA 3065	1.75	CA 3130	1.30
CA 3080	1.10	CA 3140	1.15
CA 3081	1.65	CA 3146	1.85
CA 3160	1.19		

TI

TL494	4.20	75365	1.95
TL496	1.65	75450	.59
TL497	3.25	75451	.39
75107	1.49	75452	.39
75110	1.95	75453	.39
75150	1.95	75454	.39
75154	1.95	75491	.79
75188	1.25	75492	.79
75189	1.25	75493	.89
75494	.89		

BI FET

TL071	.79	TL084	2.19
TL072	1.19	LF347	2.19
TL074	2.19	LF351	.60
TL081	.79	LF353	1.00
TL082	1.19	LF355	1.10
TL083	1.19	LF356	1.10
LF357	1.40		

. . . Just a note to extend my apprecia-
tion for the excellent service on my first
order from your company.
Placed order by 800 line . . . and a very help-
ful young lady got everything right.
. . . Thanks for the good service.

Robert H. Bainbridge





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(CALIFORNIA RESIDENTS)

27128 16Kx8 EPROM 250ns

4116 16K DYNAMIC 250ns 8/7.95

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FD200-8 For S-100 **$195.00**
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BAL-525 FOR APPLE USERS **$139.95**
- ★ ½ Height — ALPS mechanism
- ★ 100% Apple compatible
- ★ Full 1 YEAR WARRANTY

NEW

DISKETTES

NASHUA SS/DD WITH HUB RING	$15.95
VERBATIM DATALIFE DS/DD	$29.95

SPECIALS END 11/30/84

ZIF SOCKETS

ZIF = Zero Insertion Force

LEADS	UNIT PRICE
14	5.95
16	5.95
24	7.95
28	8.95
40	10.95

OPTO-ISOLATORS

4N26	1.00	MCA-7	4.25
4N27	1.10	MCA-255	1.75
4N28	.69	IL-1	1.25
4N33	1.75	ILA-30	1.25
4N35	1.25	ILQ-74	2.75
4N37	1.25	H11C5	1.25
MCT-2	1.00	TIL-111	1.00
MCT-6	1.50	TIL-113	1.75

RESISTORS

¼ WATT 5% CARBON FILM
ALL STANDARD VALUES
FROM 1 OHM TO 10 MEG OHM

50 PCS. SAME VALUE	.025
100 PCS. SAME VALUE	.02
1000 PCS. SAME VALUE	.015

BYPASS CAPS

.01 UF DISC	100/6.00
.01 UF MONOLITHIC	100/12.00
.1 UF DISC	100/8.00
.1 UF MONOLITHIC	100/15.00

DIODES

1N751	5.1 volt zener	.25
1N759	12.0 volt zener	.25
1N4148	(1N914) switching	25/1.00
1N4004	400PIV rectifier	10/1.00
KBP02	200PIV 1.5amp bridge	.45
KBP04	400PIV 1.5amp bridge	.55
VM48	Dip-Bridge	.35

MUFFIN FANS

4.68" Square	14.95
3.125" Square	14.95

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TO-3 style	.95
TO-220 style	.35

SWITCHES

SPDT mini-toggle	1.25
DPDT mini-toggle	1.50
SPST mini-pushbutton	.39

CAPACITORS

TANTALUM

	6V	10V	15V	20V	25V	35V
.22uf						.40
.27						.40
.33						.40
.47				.35		.50
.68						.45
1.0			.40	.40	.45	.45
1.5				.45		.50
1.8						.75
2.2		.35	.40	.45		.85
2.7		.40	.45			.90
3.3		.45	.50	.55	.60	.65
3.9			.45			
4.7	.45	.55		.60	.65	.85
6.8			.70		.75	
10	.55	.65	.60	.65	.90	1.00
12	.65		.65	.90		
15	.75	.85	.90			
18			1.25			
22		1.00	1.35			
27			2.25			
39		1.50				
47	1.35					
56	1.75					
100		3.25				
270	3.75					

DISC

10pf	50V	.05	470	50V	.05
22	50V	.05	560	50V	.05
25	50V	.05	680	50V	.05
27	50V	.05	820	50V	.05
33	50V	.05	.001uf	50V	.05
47	50V	.05	.0015	50V	.05
56	50V	.05	.0022	50V	.05
68	50V	.05	.005	50V	.05
82	50V	.05	.01	50V	.07
100	50V	.05	.02	50V	.07
220	50V	.05	.05	50V	.07
330	50V	.05	.1	12V	.10
			.1	50V	.12

MONOLITHIC

.1uf-mono	50V	.18	.47uf-mono	50V	.25
.047uf-mono	50V	.15	.01uf-mono	50V	.14

ELECTROLYTIC

RADIAL			AXIAL		
.47uf	50V	.14	1uf	50V	.14
1	25V	.14	4.7	16V	.14
2.2	35V	.15	10	16V	.14
4.7	50V	.15	10	50V	.16
10	50V	.15	22	16V	.14
47	35V	.18	47	50V	.20
100	16V	.18	100	15V	.20
220	35V	.20	100	35V	.25
470	25V	.30	150	25V	.25
2200	16V	.60	220	25V	.30
			330	16V	.40
			500	16V	.42
			1000	16V	.60
			1500	16V	.70
			6000	16V	.85

COMPUTER GRADE

44,000uf	30V	3.95

TRANSISTORS

2N918	.50	MPS3706	.15
MPS918	.25	2N3772	1.85
2N2102	.75	2N3903	.25
2N2218	.50	2N3904	.10
2N2218A	.50	2N3906	.10
2N2219	.50	2N4122	.25
2N2219A	.50	2N4123	.25
2N2222	.25	2N4249	.25
PN2222	.10	2N4304	.75
MPS2369	.25	2N4401	.25
2N2484	.25	2N4402	.25
2N2905	.50	2N4403	.25
2N2907	.25	2N4857	1.00
PN2907	.125	PN4916	.25
2N3055	.79	2N5088	.25
3055T	.69	PN5129	.25
2N3393	.30	PN5139	.25
2N3414	.25	2N5209	.25
2N3563	.40	2N6028	.35
2N3565	.40	2N6043	1.75
PN3565	.25	2N6045	1.75
MPS3638	.25	MPS-A05	.25
MPS3640	.25	MPS-A06	.25
PN3643	.25	MPS-A55	.25
PN3644	.25	TIP29	.65
MPS3704	.15	TIP31	.75
		TIP32	.79

IC SOCKETS

	1-99	100
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
64 pin ST	4.25	call

ST = SOLDERTAIL

8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.60

WW = WIREWRAP

RF MODULATOR

(ASTEC UM1082) QUANTITIES LIMITED

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- ★ USE TO BUILD TV-COMPUTER INTERFACE
- ★ +5 VOLT OPERATION

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	1-99	100-up
JUMBO RED	.10	.09
JUMBO GREEN	.18	.15
JUMBO YELLOW	.18	.15
LED MOUNTING HARDWARE	.10	.09

LED DISPLAYS

HP 5082-7760	.43"	CC	1.29
MAN 72	.3"	CA	.99
MAN 74	.3"	CC	.99
FND-357 (359)	.375"	CC	1.25
FND-500 (503)	.5"	CC	1.49
FND-507 (510)	.5"	CA	1.49
TIL-311 4x7	.270"	HEX W/LOGIC	9.95

DIP SWITCHES

4 POSITION	.85
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6 POSITION	.90
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TERMS: Minimum order $10. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax, Bay Area and LA residents include 6½%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

Circle 189 on inquiry card.

HM6116-4 2Kx8 STATIC cmos 200ns

2732 4Kx8 EPROM 450ns 4.95

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- ★ Color matches Apple
- ★ Fits standard 5¼" drives, inc. Shugart
- ★ Includes mounting hardware and feet

CABINET #2 $79.00

- ★ Complete with power supply, switch, line cord, fuse & standard power connector
- ★ Dimensions: 11½ x 5¾ x 3¹⁵⁄₁₆"
- ★ +5V @ 1 AMP, +12V @ 1.5 AMP
- ★ Please **specify** gray or tan

NOTE: Please include sufficient amount for shipping on above items.

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12.6VAC	2amp	4.95
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MP-52 5¼" (FOR IBM) DS/DD $249.00

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FD-55F ½ HEIGHT DS/QUAD $200.00

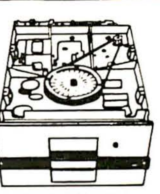
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RIBBON CABLE

CONTACTS	SINGLE COLOR 1'	SINGLE COLOR 10'	COLOR CODED 1'	COLOR CODED 10'
10	.50	4.40	.83	7.30
16	.55	4.80	1.00	8.80
20	.65	5.70	1.25	11.00
25	.75	6.60	1.32	11.60
26	.75	6.60	1.32	11.60
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44 pin WW	4.95

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DESCRIPTION	ORDER BY	8	14	16	18	20	22	24	28	40
HIGH RELIABILITY TOOLED ST IC SOCKETS	AUGATxx-ST	.99	.99	.99	1.69	1.89	1.89	1.99	2.49	2.99
COMPONENT CARRIERS (DIP HEADERS)	ICCxx	.65	.75	.85	1.00	1.25	1.25	1.35	1.50	2.10
RIBBON CABLE DIP PLUGS (IDC)	IDPxx	----	1.45	1.65	----	----	----	2.50	----	4.15

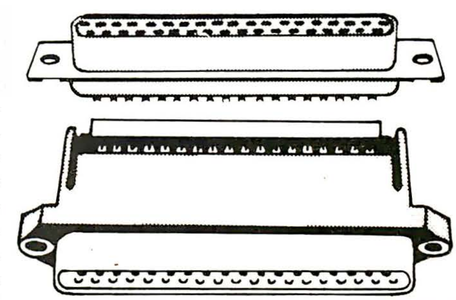
For order instructions see "IDC Connectors" below.

D-SUBMINIATURE

DESCRIPTION		ORDER BY	9	15	25	37	50
SOLDER CUP	MALE	DPxxP	2.08	2.69	2.50	4.80	6.06
	FEMALE	DBxxS	2.66	3.63	3.25	7.11	9.24
RT. ANGLE PC SOLDER	MALE	DBxxPR	1.65	2.20	3.00	4.83	---
	FEMALE	DBxxSR	2.18	3.03	4.42	6.19	---
IDC RIBBON CABLE	MALE	IDBxxP	3.37	4.70	6.23	9.22	---
	FEMALE	IDBxxS	3.69	5.13	6.84	10.08	---
HOODS	BLACK	HOOD-B	---	---	1.25	---	---
	GREY	HOOD	1.60	1.60	1.25	2.95	3.50

MOUNTING HARDWARE - $1.00

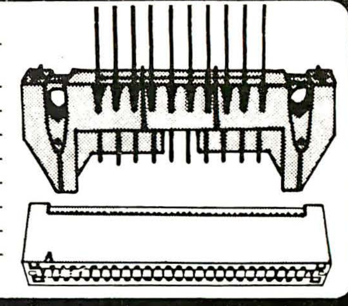
For order instructions see "IDC Connectors" below.



IDC CONNECTORS

DESCRIPTION	ORDER BY	10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RT. ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WW HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RT. ANGLE WW HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	1.15	1.86	2.43	3.15	3.73	4.65
RIBBON HEADER	IDMxx	----	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	2.25	2.36	2.65	3.25	3.80	4.74

ORDERING INSTRUCTIONS: Insert the number of contacts in the position marked "xx" of the "order by" part number listed. EXAMPLE: A 10 pin right angle solder style header would be IDH 10 SR.



Circle 189 on inquiry card.

MPI B52 DS/DD FULL HEIGHT FDD FOR IBM $139.95

130W POWER SUPPLY



XT COMPATIBLE
+5V @ 15A
+12V @ 4.2A
-5V @ .5A
-12V @ .5A

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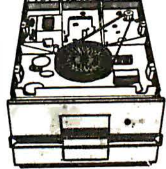
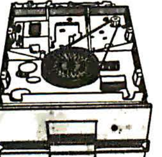
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BOTH CARDS FEATURE GLASS EPOXY WITH PLATED-THROUGH HOLES, SOLDER MASK, SILK-SCREENED, GOLD CARD-EDGE. MOUNTING BRACKETS AND INSTRUCTIONS INCLUDED.

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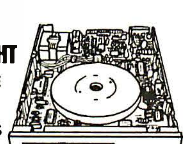
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* DS/DD — 320K

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FD 55-B 1/2 HEIGHT



* 6ms STEP RATE
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Parallel Port	1	1
Clock Calendar	YES	YES
Game Adaptor	OPTIONAL	OPTIONAL

[1] With Optional 128K MAXISTACK
[2] Second Serial Port Optional

$259.95 (64K)

OPTIONS:
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* Game Adaptor $29.95
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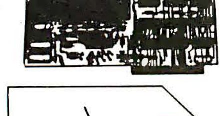
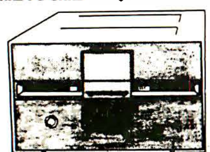
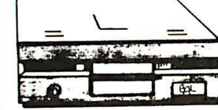
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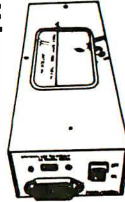
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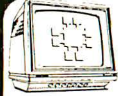


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* APPLE POWER CONNECTOR
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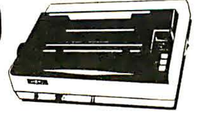
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* 75 DISK STORAGE CAPACITY

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5¼" WITH HUB RING

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8 INCH

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TERMS: Minimum order $10. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax, Bay Area and LA residents include 6½%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

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WANTED: Urgent need for IBM PC, hard disk, expansion cards, LQ printer for handicapped project. Contributions to nonprofit organization are tax deductible (IRS 503c). Handicapped & Retarded Assoc. Inc., POB 2904, Texas City, TX 77592, (713) 337-5074.

WANTED: Donations of Kaypro-, Osborne-, Commodore 64-compatible peripherals and software for overseas missionaries and Christian school. Tax-deductible receipts upon request. Will pay shipping. Reverend Ken Marks, 61476 Blakley Rd., Bend, OR 97702, (503) 389-0084.

FOR SALE: Heathkit H-10 paper-tape reader and punch with four rolls of unused tape and manuals, excellent condition, practically unused. Philip Nunn, 201 Netherfield, Comstock Park, MI 49321, (616) 784-5237.

FOR SALE: TRS-80 computer, 48K, two 40K DD disk drives, aerocomp doubler, LSIS amber nonglare screen, upper- and lowercase, RS-232C, MDX expansion interface, stringy/floppy drive, CTR-80 cassette and data-dubber; everything works, in good condition: $1200 or best offer. Tom Niderost, POB 6, Talmage, CA 95481, (707) 462-8139 between 9 a.m. and 9 p.m. PT.

WANTED: Information and computer science major in need of computer and hardware donations for school and personal use. Could pay shipping. Amy L. Justus, Route 2, Clarkesville, GA 30523.

FOR SALE: Integral Data Systems 460G, heavy-duty NLQ dot-matrix printer with serial and parallel interfaces plus graphics. 150 cps (draft); 75 cps (correspondence). Excellent condition: $500. Walter Sikonowiz, 2 Petre Dr., Auburn, NY 13021, (315) 252-3960 after 4:30 p.m. and weekends.

FOR SALE: Cromemco Z-2D. Three 16K memory boards and Tu-Art card with two serial and two parallel communication ports—RS-232C. Two Wangco 5¼-inch disk drives. 21-slot motherboard. Teletype Model 43 printing terminal. Microterm Act IV CRT terminal. Originally cost $6100, will sell for $3000. Curtis Turner, 5128 Newburg Rd., Rockford, IL 61108, (815) 397-6679 evenings.

FOR SALE: CompuPro 384K CPU with dual floppy and 23-megabyte hard disk includes spare disk drive: $7500. Bob Weber, 23850 Commerce Park Dr., Beachwood, OH 44122, (216) 831-0480.

WANTED: Student will appreciate any used or broken computer hardware. I will be responsible for all postage costs. Johnathan Jones, 1426 St. Mark's Ave., Brooklyn, NY 11233, (212) 773-5983.

FOR SALE: Advanced Digital Super-Quad SBC with one parallel and two serial adapters: $600. Two NEC FD1165 DS/DD 8-inch drives: $375 each. Sierra Data Mainframe S-100–SL/2, 7-slot: $575. H-29 terminal: $525. Will sell complete system for $2200. Mike Schwartz, RD 7232, Reading, PA 19606, (215) 779-4105.

WANTED: IBM PC XT with at least one disk drive or compatible. Also, Apple II, II+, or IIe with at least one drive. Monitors, printers, modems, and card also. Darwin D. Airola III, 1740 Lombard Ave., Apt. #1, Oshkosh, WI 54901, (414) 426-5672.

NEEDED: If you know of any horror stories that have happened to you or your computer friends in world of personal computers, let me know. I am assembling a comprehensive collection of them, including hardware, software, environmental, and operator error. Howard Hillman, 220 East 63rd St., New York, NY 10021.

FOR SALE: First year of BYTE. Best offer. Prefer local buyer. Bob Fenichel, 2200 Columbia Pike #1112, Arlington, VA 22204.

FOR SALE: Morrow Designs Micro Decision WD2 (two drives, SS/DD). Also, AMPEX D175 (amber display) with a Selectric-style keyboard and numeric and editing keypads: $549. John Birck, 458 East 600 N, Orem, UT 84057, (801) 224-4809.

FOR SALE: Two brand new Lambda LGS-5-5-OV-R high-efficiency switching power supplies with 5 volts/45 amps and overvoltage protection and remote sensing. Bought for over $325 each, but will sell for $200 each or $375 for both. Tareq Hoque, 159 North Oller Ave., Waynesboro, PA 17268, (717) 762-8406.

WANTED: If you have a modem and would like your number in a pamphlet, send your name, your modem telephone number, type of computer, and a description of what you use your modem for. Richard Grossman, 1106 Swissvale Place, Richmond, VA 23229.

FOR EXCHANGE: dBASE II end user seeks to trade tips, command files, application ideas, techniques, and more for home and business use. Trade printouts only, you must be a registered dBASE owner. SASE for details. Robert Greenwald, POB 401, Wheatley Heights, NY 11798.

WANTED: Any or all issues of Robert Wainwright's *Lifeline* newsletter about Conway's "Game of Life." Let me know what you have and what you want for them. Brad Whitlock, 6905 Holly Dr., Raleigh, NC 27609, (919) 847-6851.

WANTED: Laser Disk Sears Catalog. POB 330, Valley Mills, TX 76689.

FOR SALE: TRS-80 Model III with 48K RAM, two Tandon disk drives, Micro Mainframe FDC-3C disk controller, Alpha Products joystick, DOSPLUS 3.5 operating system, and all manuals and cables. In perfect working condition: $1200. Mark Schwabacher, 14 East 90th St., New York, NY 10128, (212) 831-1226.

FOR SALE: Terak 8510/a graphics computer, LSI-11, 64K. Two SS/DD 8-inch drives. Run only on Sundays with p-System by a Pascal fanatic. Realistic offers entertained. Mark Erenburg, POB 2102, Springfield, IL 62705, (217) 787-6036.

FOR SALE: Three HRAM64: $350 each. HRAM: $225. 4-port I/O: $275. Z-80PB: $250. ST506 and controller: $1250. MD5 controller: $200. Shugart 800/2: $200. Used less than six months. Manuals available, multiuser, TSS/C HDOS. J. M. DeFigh, 26 Brownville Ave., Ipswich, MA 01938, (617) 356-4394.

FREE: Several hundred DEC flip-chip modules, mostly from PDP-11 peripherals. If you seek spares, send wants or SASE for list. Gene Clough, Physics Dept., Bates College, Lewiston, ME 04240.

WANTED: Copy of *Beneath Apple* DOS and Apple's DOS Toolkit manual. Will pay generously for books and shipping. Scott Barnes, Star Route, Parkesburg, PA 19365, (215) 593-6454.

FOR SALE: OSI C8P-DF, whole or part, three 16K 520 boards, a 540 color board, a 505 CPU, a 495 proto board with two AY3-8910 music generators. OSI books, two joysticks, and a Bigboard ASCII keyboard. Any offer considered. Tom Kisko, Rt. 1, Box 787, Micanopy, FL 32667, (904) 466-3038.

FOR SALE: Hewlett-Packard 85A with built-in printer, high-performance tape drive, and monitor. 16K RAM module (32K total); HP-IB (IEEE-488) interface; ROMs (advanced programming, I/O, mass storage, plotter/printer); all manuals. Retail value $3500; asking $2200. Ron Riedel, 1031 Redwood Dr., Loveland, CO 80537, (303) 667-7886.

FOR SALE: BYTE 1977: April, June–September, November, December. 1978: January–July, October–December. 1979: January–May, July–November. $75 for all 27 copies. George Colman, (617) 879-4031 evenings and weekends.

WANTED: Apple system or parts (disk drives, monitors, etc.) to further my programming skills. Anything accepted. Will pay postage. Jeff Klammer, 3714 Prairie Rd., White Bear Lake, MN 55110.

FOR SALE: Apple Disk II with 3.3 DOS: $275. 80-column text card for the IIe: $45. Shipping prepaid. George W. Ziegler Jr., 16 South Bayard Lane, Mahwah, NJ 07430, (201) 934-0121.

WANTED: Used Winchester disk for Victor 9000. Gold, 11514 Burdine, Houston, TX 77035.

WANTED: Method for plotter/dot-matrix printer to create symbols in various languages (e.g., Hebrew) for plotting texts. Avraham Gutbir, 374 Merton St., Toronto, Ontario M4S 1B3, Canada, (416) 482-2244.

FOR SALE: SwTPC 69/A, 6809, 28K RAM, serial, parallel, DS/DD disk controller, and more: $600. Epson MX-80 with Graftrax: $350. Robert Alexander, 1630 Worcester Rd., Apt. 222C, Framingham, MA 01701, (617) 872-6739 evenings.

WANTED: BYTE issues 1–4, 12, and 13. Also, *Creative Computing* (any volume 1 or 2), *Personal Computing* (any volume 1 or 2), *Interface Age*, *Softline*. Thomas Kariya, POB 157, Brookeville, MD 20833.

FOR SALE: Teletype Model 33 KSR printer. Asking $150, will accept best offer. John Butera, 729 Indiana Ave., Trenton, NJ 08638, (609) 989-0946.

WANTED: Computer club seeks used computers or accessories. Will pay postage. Jim Fuller III, 6329 Cricket Lane, Columbus, GA 31909, (404) 563-8596.

WANTED: High school senior interested in computer science seeks donation or purchase of a used Apple computer and disk drive or a TRS-80 Model III with one or two disk drives. Brian Neidig, Rt. 2, Box 157cc, Taylor, TX 76574.

FOR SALE: MFE 8-inch floppy disk Model 571 and Priam 70-megabyte drive Model 5070, both never used. Also, Data General Nova and Eclipse boards, both used. Send for list. Todd Allen, 328 Richard Rd., Naperville, IL 60540.

FOR SALE: IBM 8087-3 (Intel) coprocessor chip, with IBM documentation, orig. $260; asking $160 firm. Would like to correspond with other IBM PC users in medicine. Philip Chao, 105-17 63 Rd., Forest Hills, NY 11375.

FOR SALE: 200+ 4116 dynamic RAMs; SSM SB1 music board; Tarbell cassette interface; five each 8KB static RAM boards; Jade Z80 CPU board with serial I/O; two each 19-inch rack-mount paper-tape readers. L. C. Snyder, S78W17675 Canfield Dr., Muskego, WI 53150, (414) 679-9706.

WANTED: Used QDP-100 computer. S. Ball, 289 Olmstead St., #2, Vanier, Ontario K1L 7J9, Canada.

WANTED: Information, manuals, documentation, or literature on a Datamedia 1520. Willing to buy, rent, or copy any material available. C. J. Black, 3651 Red Lion Rd., E-1, Philadelphia, PA 19114.

WILL DONATE: TRS-80 Model I 48K with expansion interface, monitor, lowercase, double-density board, "flippy-disk drive," RS-232C, joystick, gold plugs, and more. Also will sell new 64K memory extension option for DEC Rainbow 100, never used. Sells for $400; asking $200. Rick LaFlamme, 50 Blood St., Pepperell, MA 01463, (617) 433-9094.

WANTED: Sierra Data Sciences SBC-100M. State price and condition. Russ Michaelson, 1727 East 3015 South, Salt Lake City, UT 84106, (801) 467-6785.

WANTED: Information on how to create errors 20–24, 27, and 73 on Commodore 1541 disks for purpose of copy-protecting programs. David Alexander, 1667 Midland Dr., East Meadow, NY 11554.

FOR SALE: Victor 9000 with 256K bytes RAM and 2.4 megabytes of floppy-disk storage on two drives. Includes Mannesmann Tally MT-160L dot-matrix printer. Complete system with documentation: $5000. William Heubaum, 4021 Country Club Blvd., Sioux City, IA 51104, (712) 252-0711.

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JULY'S RESULTS ARE RINGING

Steve Ciarcia's Circuit Cellar project, "A Musical Telephone Bell," proved to be the most popular feature in the July issue. Next on the poll appears Jerry Pournelle's Computing at Chaos Manor column, "The AT&T Computers." In third place is the review of Borland International's Pascal compiler, netting Tom Wadlow $100 for "Turbo Pascal." Jerry Pournelle gains another mention for "The West Coast Faire" that placed fourth in the lineup this month. In fifth place, and bringing its author the $50 bonus, is Rik Jadrnicek's "Symphony: A Full-Orchestra Version of Lotus 1-2-3." (Rik is eligible for this bonus because his article was submitted prior to his appointment as a BYTE Contributing Editor.) Congratulations, authors.

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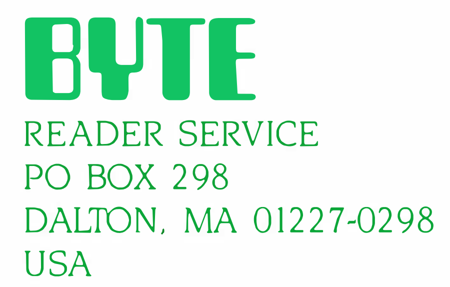
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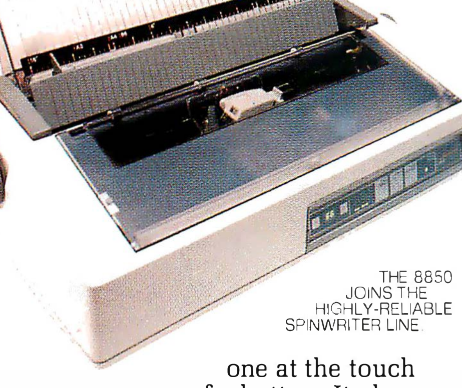
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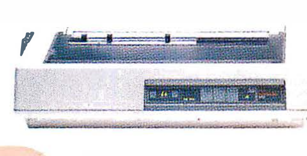
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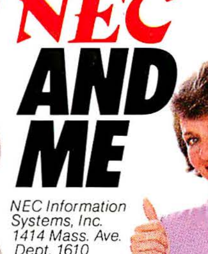
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